REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**239-8076**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**10/09/2015**

Question No. 16-90

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

The applicant is requested to consistently refer to the associated automatic operating bypass removal function channel(s) associated with RPS and ESFAS instrument[ation] Functions, which have the automatic operating bypass removal feature, in LCO, Condition, Required Action, and Surveillance statements in generic TS Section 3.3. For example, in generic TS 3.3.1 and 3.3.2, the following phrases are used for the associated automatic operating bypass removal function channels:

LCO 3.3.1 ... associated operating bypass removal channels...
Condition C ... one operating bypass removal channel...
Condition D ... two operating bypass removal channels...
Required Action C.1 … bypass channel.
Required Action C.2.2 … operating bypass removal channel…
Required Action D.1 … bypass channel.
SR 3.3.1.9 … on each trip channel, including operating bypass removal functions…
SR 3.3.1.12 … automatic operating bypass removal channel.
LCO 3.3.2 … bypass removal channels…
Condition C ... one automatic bypass removal channel...
Condition D ... two automatic bypass removal channels...

Required Action C.1 … bypass channel.
Required Action C.2.2 … operating bypass removal channel…
SR 3.3.2.3 … each automatic bypass removal function.
SR 3.3.2.4 … on each [trip channel], including bypass removal function…

Although STS Section 3.3 is similarly inconsistent, the intent of the TS Writer's Guide is to use consistent terminology in improved TS. This comment also applies to the Section 3.3 Bases.

Response – (Rev. 1)

In order to keep consistency and improve clarity in operating bypass related terminologies in TS, the phrase "automatic operating bypass removal" will be consistently incorporated into DCD Tier 2 TS Sections 3.3.1, 3.3.2, and 3.3.5 and associated TS Bases.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specifications 3.3.1, 3.3.2 and 3.3.5 and the associated Bases will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

3.3 INSTRUMENTATION

3.3.1 Reactor Protection System (RPS) Instrumentation – Operating

automatic

LCO 3.3.1 Four RPS trip and ~~associated~~ operating bypass removal channels for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1

---------- NOTE ----------

1. Separate Condition entry is allowed for each RPS Function.
2. When one channel is bypassed and the bypassed condition exceeds 7 days, whether the operation with bypass state in one channel is allowed during Completion Times identified in Required Action A.2 or C.2.2 shall be reviewed within the next 24 hours in accordance with administrative controls.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one automatic RPS trip channel inoperable.	A.1 Place channel in bypass or trip. AND A.2 Restore trip channel to OPERABLE status.	1 hour Prior to next entry into MODE 2 following entry into MODE 5
B. One or more Functions with two trip channels inoperable.	---------- NOTE ---------- Only required to be met when COLSS is out of service. With COLSS in service, LHR is continuously monitored. --- B.1 Place one trip channel in bypass and the other in trip.	 1 hour

Disable automatic operating bypass removal channel.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One or more Functions with one operating bypass removal channel inoperable.	C.1 ~~Disable bypass channel~~. OR C.2.1 Place affected automatic trip channel in bypass or trip. AND C.2.2 Restore operating bypass removal channel and associated automatic trip channel to OPERABLE status.	1 hour 1 hour Prior to next entry into MODE 2 following entry into MODE 5
D. One or more Functions with two operating bypass removal channels inoperable.	---------- NOTE ---------- LCO 3.0.4 is not applicable. ---------- D.1 ~~Disable bypass channels~~. OR D.2 Place one affected automatic trip channel in bypass and place the other in trip.	 1 hour 1 hour
E. Required Action and associated Completion Time not met.	E.1 Be in MODE 3.	6 hours

automatic

Disable automatic operating bypass removal channels.

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.8	NOTE Excore neutron detectors are excluded from CHANNEL CALIBRATION. Perform CHANNEL CALIBRATION of linear power of excore neutron flux channel in accordance with Setpoint Control Program.	31 days
SR 3.3.1.9	NOTE Excore neutron detectors are excluded from CHANNEL CALIBRATION. automatic Perform CHANNEL CALIBRATION on each trip channel, including operating bypass removal functions in accordance with Setpoint Control Program.	18 months
SR 3.3.1.10	Perform CHANNEL FUNCTIONAL TEST on each CPC channel in accordance with Setpoint Control Program.	18 months
SR 3.3.1.11	Using incore detectors, verify shape annealing matrix elements to be used by the CPCs in accordance with Setpoint Control Program.	Once after each refueling prior to exceeding 80 % RTP
SR 3.3.1.12	Perform CHANNEL FUNCTIONAL TEST on each automatic operating bypass removal channel.	Once within 31 days prior to each reactor startup
SR 3.3.1.13	NOTE Excore neutron detectors are excluded. Verify RPS RESPONSE TIME is within limits.	18 months on a STAGGERED TEST BASIS

3.3 INSTRUMENTATION

3.3.2 Reactor Protection System (RPS) Instrumentation – Shutdown

automatic operating

LCO 3.3.2 Four RPS trip and bypass removal channels for each Function in Table 3.3.2-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.2-1

ACTIONS

NOTE

1. Separate Condition entry is allowed for each RPS Function.
2. When one channel is bypassed and the bypassed condition exceeds 7 days, whether the operation with bypass state in one channel is allowed during Completion Times identified in Required Action A.2 or C.2.2 shall be reviewed within the next 24 hours in accordance with administrative controls.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one automatic RPS trip channel inoperable.	A.1 Place channel in bypass or trip. AND A.2 Restore trip channel to OPERABLE status.	1 hour Prior to next entry into MODE 2 following entry into MODE 5
B. One or more Functions with two automatic RPS trip channels inoperable.	B.1 Place one trip channel in bypass and the other in trip.	1 hour

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One automatic bypass removal channel inoperable.	C.1 Disable bypass channel. OR C.2.1 Place affected automatic trip channel in bypass or trip. AND C.2.2 Restore operating bypass removal channel and associated automatic trip channel to OPERABLE status.	1 hour 1 hour Prior to next entry into MODE 2 following entry into MODE 5
D. Two automatic bypass removal channels inoperable.	D.1 Disable bypass channels. OR D.2 Place one affected automatic trip channel in bypass and place the other in trip.	1 hour 1 hour
E. Required Action and associated Completion Time not met.	E.1 Open all RTSGs.	1 hour

SURVEILLANCE REQUIREMENTS

NOTE

Refer to Table 3.3.2-1 to determine which SR shall be performed for each RPS Function.

	SURVEILLANCE	FREQUENCY
SR 3.3.2.1	Perform CHANNEL CHECK of each logarithmic power channel.	12 hours
SR 3.3.2.2	Perform CHANNEL FUNCTIONAL TEST on each logarithmic power channel in accordance with Setpoint Control Program.	31 days
SR 3.3.2.3	Perform CHANNEL FUNCTIONAL TEST on each automatic bypass removal function. operating	Once within 31 days prior to each reactor startup
SR 3.3.2.4	NOTE Neutron detectors are excluded from CHANNEL CALIBRATION. automatic operating Perform CHANNEL CALIBRATION on each logarithmic power channel, including bypass removal function in accordance with Setpoint Control Program.	18 months
SR 3.3.2.5	Verify RPS RESPONSE TIME is within limits.	18 months on a STAGGERED TEST BASIS

3.3 INSTRUMENTATION

3.3.5 Engineered Safety Features Actuation System (ESFAS) Instrumentation

and automatic

LCO 3.3.5 Four ESFAS trip ~~channels and associated~~ operating bypass removal channels for each Function in Table 3.3.5-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.5-1.

ACTIONS

NOTE

1. Separate Condition entry is allowed for each ESFAS Function.
2. When one channel is bypassed and the bypassed condition exceeds 7 days duration, it shall be reviewed in 24 hours whether to maintain the operation in bypassed condition within the specified Completion Time of the Required Action A.2 or administrative controls.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one automatic ESFAS trip channel inoperable.	A.1 Place trip channel in bypass or trip. AND A.2 Restore trip channel to OPERABLE status.	1 hour Prior to next entry into MODE 2 following entry into MODE 5
B. One or more Functions with two trip channels inoperable.	NOTE LCO 3.0.4 is not applicable. B.1 Place one trip channel in bypass and the other in trip.	 1 hour

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.3.5.1	Perform CHANNEL CHECK of each ESFAS channel.	12 hours
SR 3.3.5.2	Perform CHANNEL FUNCTIONAL TEST of each ESFAS channel in accordance with Setpoint Control Program.	31 days
SR 3.3.5.3	Perform CHANNEL CALIBRATION of each ESFAS channel, including bypass removal function in accordance with Setpoint Control Program.	18 months
SR 3.3.5.4	Verify ESFAS RESPONSE TIME is within limits.	18 months on a STAGGERED TEST BASIS
SR 3.3.5.5	Perform CHANNEL FUNCTIONAL TEST on each automatic operating bypass removal channel.	Once within 31 days prior to each reactor startup

automatic operating

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.12

removal

SR 3.3.1.12 is a CHANNEL FUNCTIONAL TEST similar to SR 3.3.1.7 is applicable only to automatic operating bypass functions and is performed once within 31 days prior to each startup. Proper operation by operating bypass permissive is critical during plant startup because the operating bypass must be in place to allow startup operation and must be automatically removed at the appropriate points during power ascent to enable certain reactor trips.

Consequently, the appropriate time to verify bypass removal function OPERABILITY is just prior to startup.
Once the operating bypasses are removed, the bypasses must not fail in such a way that the associated trip function gets inadvertently bypassed. This feature is verified by the trip function CHANNEL FUNCTIONAL TEST, SR 3.3.1.7. Therefore, further testing of the bypass removal function after startup is unnecessary.

SR 3.3.1.13

This SR ensures that the RPS RESPONSE TIMES are verified to be less than or equal to the maximum values assumed in the safety analysis. Individual component response times are not modeled in the analyses. The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the trip setpoint value at the sensor to the point at which the RTSGs open. Response times are conducted on an 18-month STAGGERED TEST BASIS. This results in the interval between successive surveillances of a given channel of n × 18 months, where n is the number of channels in the function. The Frequency of 18 months is based upon operating experience, which has shown that random failures or instrumentation components causing serious response time degradation, but not channel failure at power, are infrequent occurrences. Also, response times cannot be determined at power, since equipment operation is required. Testing may be performed in one measurement or in overlapping segments, with verification that all components are tested.

A Note is added to indicate that the excore neutron detectors may be excluded from RPS RESPONSE TIME testing because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated for by performing the daily calorimetric calibration (SR 3.3.1.4).

BASES

ACTIONS (continued)

B.1

Condition B applies to the failure of two Logarithmic Power Level – High trip channels or associated instrument channels. Required Action B.1 provides for placing one inoperable channel in bypass and the other channel in trip within the Completion Time of 1 hour. This Completion Time is sufficient to allow the operator to take all appropriate actions for the failed channels and still ensures the risk involved in operating with the failed channels is acceptable. With one channel of protection instrumentation bypassed, the RPS is in a two-out-of-three logic; but with another channel failed, the RPS could be operating in a two-out-of-two logic. This is outside the assumptions made in the analyses and should be corrected. To correct the problem, the second channel is placed in trip. This places the RPS in a one-out-of-two logic. If any of the other OPERABLE channels receives a trip signal, the reactor will trip.

One of the two inoperable channels will need to be restored to OPERABLE status prior to the next required CHANNEL FUNCTIONAL TEST because channel surveillance testing on an OPERABLE channel requires that the OPERABLE channel be placed in bypass. However, it is not possible to bypass more than one RPS channel and placing a second channel in trip will result in a reactor trip. Therefore, if one RPS channel is in trip and a second channel is in bypass, a third inoperable channel would place the unit in LCO 3.0.3.

C.1, C.2.1, and C.2.2

operating

Condition C applies to one automatic bypass removal channel inoperable. If the bypass removal channel for the high logarithmic power level operating bypass cannot be restored to OPERABLE status within 1 hour, the associated RPS channel may be considered OPERABLE only if the bypass is not in effect. Otherwise, the affected RPS channel must be declared inoperable, as in Condition A, and the bypass either removed or the affected automatic channel placed in trip or bypass. Both the bypass removal channel and the associated automatic trip channel must be repaired prior to entering MODE 2 following the next MODE 5 entry. The Bases for the Required Actions and required Completion Times are consistent with Condition A.

BASES

ACTIONS (continued)

D.1 and D.2

operating

Condition D applies to two inoperable automatic bypass removal channels. If the bypass removal channels for two operating bypasses cannot be restored to OPERABLE status within 1 hour, the associated RPS channel may be considered OPERABLE only if the bypass is not in effect. Otherwise, the affected RPS channels must be declared inoperable, as in Condition B, and the bypass either removed or one automatic trip channel placed in bypass and the other in trip within 1 hour. The restoration of one affected bypassed automatic trip channel must be completed prior to the next CHANNEL FUNCTIONAL TEST or the plant must shut down per LCO 3.0.3, as explained in Condition B. Completion Times are consistent with Condition B.

E.1

Condition E is entered when the Required Actions and associated Completion Times of Condition A, B, C, or D are not met.

If Required Actions associated with these Conditions cannot be completed within the required Completion Time, all RTSGs must be opened, placing the plant in a condition where the logarithmic power trip channels are not required to be OPERABLE. A Completion Time of 1 hour is a reasonable time to perform the Required Action, which maintains the risk at an acceptable level while having one or two channels inoperable.

SURVEILLANCE REQUIREMENTS

The SRs for the Logarithmic Power Level – High trip are an extension of those listed in LCO 3.3.1, listed here because of their Applicability in these MODES.

SR 3.3.2.1

SR 3.3.2.1 is the performance of a CHANNEL CHECK of each logarithmic power channel. This SR is identical to SR 3.3.1.1. Only the Applicability differs.

Performance of the CHANNEL CHECK once every 12 hours ensures that gross failure of instrumentation has not occurred.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.3

SR 3.3.2.3 is a CHANNEL FUNCTIONAL TEST similar to SR 3.3.2.2, except SR 3.3.2.3 is applicable only to bypass functions and is performed once within 31 days prior to each startup. This SR is identical to SR 3.3.1.12. Only the Applicability differs.

automatic operating

Proper operation of bypass permissives is critical during plant startup because the bypasses must be in place to allow startup operation and must be removed at the appropriate points during power ascent to enable certain reactor trips. Consequently, the appropriate time to verify bypass removal function OPERABILITY is just prior to startup. Once the operating bypasses are removed, the bypasses must not fail in such a way that the associated trip Function gets inadvertently bypassed. This feature is verified by the trip Function CHANNEL FUNCTIONAL TEST, SR 3.3.2.2. Therefore, further testing of the bypass function after startup is unnecessary.

SR 3.3.2.4

This SR is identical to SR 3.3.1.9. Only the Applicability differs.

CHANNEL CALIBRATION is a complete check of the instrument channel excluding the sensor. The Surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drift between successive calibrations to ensure that the channel remains operational between successive tests. The SCP has controls which require verification that the instrument channel functions as required by verifying the as-left and as-found setting are consistent with those established by the setpoint methodology. Allowable Values and nominal trip setpoints are specified for this RPS trip Function in the SCP setpoint calculations. The nominal setpoint is selected to ensure the setpoint measured by CHANNEL FUNCTIONAL TESTS does not exceed the Allowable Value if the bistable is performing as required. Operation with a trip setpoint less conservative than the nominal trip setpoint, but within its Allowable Value, is acceptable provided that operation and testing are consistent with the assumptions of the plant specific setpoint calculations.

BASES

LCO (continued)

When the trip setpoint has been lowered below the operating bypass permissive setpoint of 28.1 kg/cm^{2}A (400 psia), the Pressurizer Pressure – Low reactor trip, CIAS, and SIAS actuation may be manually bypassed in preparation for shutdown cooling. When pressurizer pressure rises above bypass removal setpoint of 35.2 kg/cm^{2}A (500 psia), the bypass is removed.

Bypass Removal

automatic

This LCO requires the operating bypass removal function for all four Pressurizer Pressure – Low trip channels to be OPERABLE in MODES 1, 2, 3, and 4.

Each of the four channels enables and disables the operating bypass capability for a single channel. Therefore, this LCO applies to the operating bypass removal feature only. If the operating bypass enable function is failed so as to prevent entering a bypass condition, operation may continue. Since the trip setpoint has a floor value of 7.0 kg/cm^{2}A (100 psia), a channel trip will result if pressure is decreased below this setpoint without bypassing.

The operating bypass removal Allowable Value was chosen because MSLB events originating from below this setpoint add less positive reactivity than that which can be compensated for by required SDM.

BASES

SURVEILLANCE REQUIREMENTS (continued)

This sequence consists of SRs 3.3.5.2, 3.3.6.1, and 3.3.6.2 and tests the entire ESFAS from bistable input to actuational output. These overlapping tests are described in DCD Tier 2 Section 7.3 (Reference 1).

SRs 3.3.5.2 and 3.3.6.1 are performed together and in conjunction with ESFAS testing. SR 3.3.6.2 verifies that each subgroup can actuate ESFAS equipment when actuational output of each subgroup is generated.

These tests verify that the ESFAS is capable of performing its intended function, from bistable through the actuated components. SRs 3.3.6.1 and 3.3.6.2 are described in LCO 3.3.6. SR 3.3.5.2 includes bistable logic testing.

To assure the trip occurrence by bistable logic within Allowable Value of setpoint, test signal is infected in only one channel at a time. This is performed in bypassed status of corresponding RPS trip channel. Setpoint adjustment must be performed consistent with the plant specific setpoint analysis.

SR 3.3.5.3

automatic

CHANNEL CALIBRATION is a complete check of the instrument channel including the detector and the operating bypass removal Functions.

The Surveillance verifies that the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations to ensure that the channel remains operational between successive Surveillances. CHANNEL CALIBRATION must be performed consistent with the plant specific setpoint analysis.

The 18-month Frequency is based upon the possibility for the necessity of surveillance activity and upon the unexpected transients in case when the check is performed at plant operation.

SR 3.3.5.4

This Surveillance ensures that the actuation response times are within the maximum values assumed in the safety analyses.

Response time testing acceptance criteria are included in DCD Tier 2 Section 7.3 (Reference 1).

REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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Docket No. 52-046

RAI No.:	**239-8076**
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Application Section:	**16.3.3**
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Question No. 16-96

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

SRP Section 16.0, Part III.2.A states, in part, “when reviewing a difference between the proposed TS provision and the reference TS provision, verify that the applicant’s written technical or administrative reasoning in support of the difference is logical, complete, and clearly written.”

Page 26 of Deviation Report between NUREG-1432 Rev. 4.0 and APR1400 Technical Specifications APR1400-K-O-NR-13001-NP justifies:

a. Removing the word "shall" from STS SR 3.3.1.7 surveillance column Note 1 by asserting it is an editorial change. The proposed change is indicated by the following markup of the note:

   The CPC CHANNEL FUNCTIONAL TEST ~~shall include~~ **includes** verification that ~~the~~ correct values of addressable constants are installed in each OPERABLE CPC.

   The proposed difference from STS SR 3.3.1.7 Note 1 conveys a different meaning that is less restrictive. The STS phrasing is correct and clear. Request applicant use the STS Note to be consistent with STS.

b. Using reactor trip switch gear (RTSG) instead of reactor trip circuit breaker (RTCB) by saying generic TS SR 3.3.1.7 "NOTE 2 reflects intrinsic design characteristic of APR1400." There appears to be no logical difference between the two terms for these circuit breakers, of which there are eight, two per PPS division (which constitutes a RTCB channel) in two sets of four. Request applicant to be consistent with STS and use term "RTCB" in generic TS Section 3.3 and Bases, since RTCB is used almost exclusively in most other generic TS Sections.

Response – (Rev. 1)

a. The statement in the Notes for SR 3.3.1.7 will be replaced with the following statement from the STS:

"The CPC CHANNEL FUNCTIONAL TEST shall include verification that the correct values of addressable constants are installed in each OPERABLE CPC."

b. The term "RTSG" used in generic TS Section 3.3 and the associated Basis will be replaced with "RTCB."

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specifications SR 3.3.1.7, 3.3.1, 3.3.2, and 3.3.5 and B3.3.1, B3.3.2, B3.3.3, B3.3.4, and B3.3.13 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.5	---------- NOTE ---------- The performance shall be completed within 12 hours after THERMAL POWER ≥ 80 % RTP. ---------- Verify total RCS flow rate indicated by each CPC is less than or equal to RCS flow rate determined by secondary calorimetric calculations.	31 days
SR 3.3.1.6	---------- NOTE ---------- The performance shall be completed within 12 hours after THERMAL POWER ≥ 15 % RTP ---------- Verify linear power subchannel gains of excore neutron detectors are consistent with values used to establish shape annealing matrix elements in the CPCs.	31 days
SR 3.3.1.7	---------- NOTE ---------- 1. The CPC CHANNEL FUNCTIONAL TEST ~~includes~~ verification that correct values of addressable constants are installed in each OPERABLE CPC. 2. Not required to be performed for Logarithmic Power Level – High until 2 hours after reducing THERMAL POWER below 10^{-3} % RTP and only if reactor trip ~~switchgears (RTSGs)~~ are open. ---------- Perform CHANNEL FUNCTIONAL TEST for each RPS instrumentation channel in accordance with Setpoint Control Program.	31 days

shall include

the

circuit breakers (RTCBs)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One automatic bypass removal channel inoperable.	C.1 Disable bypass channel. OR C.2.1 Place affected automatic trip channel in bypass or trip. AND C.2.2 Restore operating bypass removal channel and associated automatic trip channel to OPERABLE status.	1 hour 1 hour Prior to next entry into MODE 2 following entry into MODE 5
D. Two automatic bypass removal channels inoperable.	D.1 Disable bypass channels. OR D.2 Place one affected automatic trip channel in bypass and place the other in trip.	1 hour 1 hour
E. Required Action and associated Completion Time not met.	E.1 Open all ~~RTSGs~~ RTCBs.	1 hour

Table 3.3.2-1 (Page 1 of 1)
Reactor Protection System Instrumentation – Shutdown

FUNCTION	APPLICABLE MODES or OTHER SPECIFIED CONDITION	SURVEILLANCE REQUIREMENTS
1. Logarithmic Power Level – High[a]	3[b], 4[b], 5[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.3 SR 3.3.2.4 SR 3.3.2.5
2. Steam Generator Pressure #1 – Low[c]	3[b], 4[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.5
3. Steam Generator Pressurze #2 – Low[c]	3[b], 4[b]	SR 3.3.2.1 SR 3.3.2.2 SR 3.3.2.4 SR 3.3.2.5

circuit breakers (RTCBs)

(a) Trip may be bypassed when THERMAL POWER is ≥ 10^{-3} % RTP. Operating bypass shall be automatically removed when THERMAL POWER is < 10^{-3} % RTP.

(b) With any reactor trip ~~switchgears (RTSGs)~~ closed, any control element assembly (CEA) capable of being withdrawn, and fuel loaded in reactor.

(c) Steam Generator Pressure – Low trip setpoint may be manually decreased as steam generator pressure is reduced in MODE 3 and 4, provided the margin between steam generator pressure and the setpoint is maintained at 14.1 kg/cm^{2}A (200 psia). The setpoint shall be increased automatically as steam generator pressure is increased.

3.3 INSTRUMENTATION

3.3.4 Reactor Protection System (RPS) Logic and Trip Initiation

LCO 3.3.4 Four RPS logic channels (Coincidence, Initiation Logic), four channels of ~~Reactor Trip Switchgears (RTSGs)~~, and four manual trip channels shall be OPERABLE.

reactor trip circuit breakers (RTCBs)

APPLICABILITY: MODES 1 and 2,
MODES 3, 4, and 5, with any ~~RTSGs~~ RTCBs closed and any control element assemblies capable of being withdrawn.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ---------- NOTE ---------- ~~RTSGs~~ RTCBs associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST ---------- One channel of Manual Trip, ~~RTSG~~ RTCB, or RPS logic inoperable in MODE 1 or 2.	A.1 Open affected ~~RTSGs~~ RTCBs.	1 hour
B. ---------- NOTE ---------- ~~RTSGs~~ RTCBs associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST ---------- One channel of Manual Trip, ~~RTSG~~ RTCB, or RPS logic inoperable in MODE 3, 4, or 5.	B.1 Open affected ~~RTSGs~~ RTCBs.	48 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Two channels of Manual Trip, ~~RTSG~~, or RPS logic affecting the same trip leg inoperable.	C.1 Open affected ~~RTSGs~~. RTCBs	Immediately
D. Required Action and associated Completion Time of Condition A or C not met. OR One or more Functions with more than two channels of Manual Trip, ~~RTSG~~, or RPS logic inoperable for reasons other than Condition C.	D.1 Be in MODE 3. AND D.2 Open all ~~RTSGs~~. RTCBs	6 hours 6 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.4.1	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and ~~RTSG~~ channel. RTCB	31 days
SR 3.3.4.2	Perform CHANNEL FUNCTIONAL TEST, including separate verification of undervoltage and shunt trips, on each ~~RTSG~~. RTCB	18 months
SR 3.3.4.3	Perform CHANNEL FUNCTIONAL TEST on each RPS manual trip channel.	31 days
SR 3.3.4.4	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and ~~RTSG~~ channel. RTCB	31 days

3.3 INSTRUMENTATION

3.3.13 Logarithmic Power Monitoring Channels

LCO 3.3.13 Two logarithmic power level monitoring instrumentation shall be OPERABLE.

circuit breakers (RTCBs)

APPLICABILITY: MODES 3, 4, and 5 with the reactor trip ~~switchgears (RTSGs)~~ open or control element assembly (CEA) drive system not capable of CEA withdrawal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channel(s) inoperable.	A.1 ---------- NOTE ---------- Limited plant cooldown or boron dilution is allowed provided the change is accounted for in the calculated SDM. ---------- Suspend all operations involving positive reactivity additions. <u>AND</u> A.2 Perform SDM verification in accordance with SR 3.1.1.1 if T_{cold} > 99 °C (210 °F) or SR 3.1.2.1 if T_{cold} ≤ 99 °C (210 °F).	Immediately 4 hours <u>AND</u> Once per 12 hours thereafter

BASES

BACKGROUND (continued)

Accidents are events that are analyzed even though they are not expected to occur during the plant life. The acceptable limit during accidents is that the offsite dose shall be maintained within an acceptable fraction of 10 CFR 50.34 (Reference 2) limits. Different accident categories allow a different fraction of these limits based on probability of occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The reactor trip system (RTS) is a safety system which initiates reactor trips. The RTS consists of four channels of sensors, auxiliary process cabinet-safety (APC-S) cabinets, excore neutron flux monitoring system (ENFMS) cabinets, core protection calculator system (CPCS) cabinets, the reactor protection system (RPS) portion of plant protection system (PPS) cabinets, and reactor trip switchgear system (RTSS) cabinets.

The RPS function is performed through the below portions in the RTS.

a. Measurement channels – consist of the sensor and transmitter providing a process value to bistable logics.

b. Bistable logics – provide trip signal to RPS logic comparing the process value with predetermined setpoint. There are two bistable racks (including separate input and output modules, data links, one bistable processor, etc.) per channel.

reactor trip circuit breakers (RTCBs)

c. RPS logic – provides trip signal to ~~RTSG~~ after performing 2/4 logic based on bistable trip status of four channels. There are two local coincidence logic racks (including separate input and output modules, data links, four local coincidence logic processors, etc.) per channel.

Reactor Trip Switchgear System (RTSS)

RTCBs

d. ~~RTSG~~ – opens ~~trip switchgear~~ based on trip signal from RPS logic. ~~RTSG consists of~~ undervoltage trip equipment and shunt trip equipment. The PPS interfaces with the undervoltage trip device of ~~RTSS breakers~~. The DPS interfaces with the shunt trip device of the ~~RTSS breakers~~.

Each RTCB has

the RTCBs

RTCBs

RTCBs

This LCO addresses measurement channels and bistable trip logics and automatic operating bypass removal features for those trips with operating bypasses. The RPS logic and ~~RTSGs~~ are addressed in LCO 3.3.4, “Reactor Protection System (RPS) Logic and Trip Initiation.” The CEACs are addressed in LCO 3.3.3, “Control Element Assembly Calculators (CEACs).”

BASES

BACKGROUND (continued)

Measurement Channels

Measurement channels, consisting of the sensor, transmitter, and related instruments, provide a measurable signal based upon the physical characteristics of the parameter being measured. The excore nuclear instrumentation and the core protection calculator systems (CPCS), though complex, are considered components in the measurement channels of the Variable Overpower – High, Logarithmic Power Level – High, DNBR – Low, and Local Power Density (LPD) – High trips.

Four identical measurement channels, designated channels A through D, with electrical and physical separation, are provided for each parameter used in the generation of trip signals, with the exception of the control element assembly (CEA) position indication used in the CPCs. Each measurement channel provides input to one or more RPS bistables within the same RPS channel. In addition, some measurement channels can be used as inputs to engineered safety features actuation system (ESFAS) bistables, and most provide indication in the MCR. Measurement channels used as input of RPS meet the independence requirements from control signals.

When a channel monitoring a parameter exceeds a predetermined setpoint, indicating an unsafe condition, the bistable monitoring the parameter in that channel will trip. Tripping bistables monitoring the same parameter in two or more channels will de-energize local coincidence logic, which in turn de-energizes the initiation logic. This causes all eight ~~RTSGs~~ to open, interrupting power to the CEAs, allowing them to fall into the core.

RTCBs

Three of the four measurement channels and bistable logics channels are necessary to meet the redundancy and testability of 10 CFR Part 50, Appendix A, GDC 21 (Reference 1). The fourth channel provides additional flexibility by allowing one channel to be removed from service (trip channel bypass) for maintenance or testing, while still maintaining a minimum two-out-of-three logic. Thus, even with a channel inoperable, no single additional failure in the RPS can either cause an inadvertent trip or prevent a required trip from occurring.

BASES

BACKGROUND (continued)

The trip setpoints used in the bistables are based on the analytical limits derived from the accident analysis of DCD TIER 2 (Reference 4). The selection of these trip setpoints is such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment errors for those RPS channels that must function in harsh environments as defined by 10 CFR 50.49 (Reference 5), Allowable Values specified in SCP, in the accompanying LCO, are conservatively adjusted with respect to the analytical limits. The nominal trip setpoint entered into the bistable is normally still more conservative than that specified by the Allowable Value to account for changes in random measurement errors detectable by a CHANNEL FUNCTIONAL TEST. One example of such a change in measurement error is drift during the interval between surveillances. A channel is inoperable if its actual setpoint is not within its Allowable Value.

Setpoints in accordance with the Allowable Value will ensure that SLs are not violated during AOOs and the consequences of DBAs will be acceptable, providing the plant is operated from within the LCOs at the onset of the AOO or DBA and the equipment functions as designed.

Note that in LCO 3.3.1, the Allowable Values of SCP are the LSSS.

Functional testing of the entire RPS, from bistable input through the opening of individual sets of ~~RTSCs~~ RTCBs, can be performed either at power or shut down and is normally performed on a 31-day basis. Excore nuclear instrumentation, the CPCS, and the CEACs can be similarly tested. DCD Tier 2, Section 7.2 provides more detail on RPS testing. Processing transmitter calibration is normally performed on a refueling basis.

RPS Logic

The RPS Logic, addressed in LCO 3.3.4, consists of both local coincidence and initiation logic and employs a scheme that provides a reactor trip when bistables in any two of the four channels sense the same input parameter trip. This is called a two-out-of-four trip logic.

BASES

BACKGROUND (continued)

Each LCL receives four trip signals, one from its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. The LCL also receives the trip channel bypass status signals associated with each of the above mentioned bistables. The function of the LCL is to generate a coincidence signal whenever two or more like bistables are in a tripped condition. The LCL takes into consideration the trip bypass input state when determining the coincidence logics state. Designating the protection channels as A, B, C, and D, with no trip bypass present, the LCL will produce a coincidence signal for any of the following trip inputs: AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, and ABCD. These represent all possible two or more trip combinations of the four protection channels. Should a trip bypass be present, the logic will provide a coincidence signal when two or more of the three un-bypassed bistables are in a tripped condition.

On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state.

In addition to a coincidence signal, each LCL also provides bypass status outputs. The bypass status is provided to verify that a bypass has actually been entered into the logic either locally or remotely via the maintenance and test panel or the operator's module.

The inputs to the initiation logic are the LCL outputs from the appropriate LCLs. The LCL outputs are arranged in the initiation circuit to provide two-out-of-four coincidence. This configuration will avoid spurious channel initiation in the event of a single LCL processor or digital output module failure. The RPS initiation logic consists of an “OR” circuit for each undervoltage and shunt trip relay and de-energizes interposing relays. Each interposing relay opens ~~one switchgear in RTSG~~ one RTCB in turn. RTCBs

Each trip path is responsible for opening two of eight ~~RTSGs~~. The PPS interfaces with the undervoltage trip device of RTSS breakers. The DPS interfaces with the shunt trip device of the RTSS breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs).

BASES

BACKGROUND (continued)

It is possible to change the two-out-of-four RPS logic to a two-out-of-three logic for a given input parameter in one channel at a time by trip channel bypassing. Thus, the bistable logic will function normally, producing normal trip indication and annunciation, but a reactor trip will not occur unless two additional channels indicate a trip condition. Trip channel bypassing can be simultaneously performed on any number of parameters in any number of channels, providing each parameter is bypassed in only one channel at a time. Trip channel bypassing is normally employed during maintenance or testing.

Two-out-of-three logic also prevents inadvertent trips caused by any single channel failure in a trip condition. In addition to the trip channel bypasses, there are also operating bypasses on select RPS trips. These bypasses are enabled manually in all four RPS channels when plant conditions do not warrant the specific trip protection. All operating bypasses are automatically removed when enabling bypass conditions are no longer satisfied.

Operating bypasses are implemented in the bistable logic, so that normal trip indication is also disabled. Trips with operating bypasses include Pressurizer Pressure – Low, Logarithmic Power Level – High, and CPC (DNBR – Low and LPD – High).

Reactor Trip Circuit Breaker (RTCB)

~~Reactor Trip Switchgear (RTSG)~~

RTCBs

The reactor trip switchgear, addressed in LCO 3.3.4, consists of eight ~~RTSGs~~. Power input to the reactor trip switchgear comes from two full capacity MG sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs.

RTCBs

RTCBs

There are two separate CEDM power supply buses, each bus powering half of the CEDMs. The RTSS consists of one set of four ~~RTSGs~~ (RTSS 1) and another set of four ~~RTSGs~~ (RTSS 2). Each RTSS channel consists of two ~~reactor trip switchgears (RTSGs)~~. The eight ~~RTSGs~~ are connected ~~with 2-out-of-4 configuration.~~

RTCBs

RTCBs

in a 2-out-of-4 logic configuration

BASES

BACKGROUND (continued)

RTCBs

Each of the two trip legs consists of two ~~RTSGs~~ in each RTSS in series. The two ~~RTSGs~~ within a trip leg are actuated by separate initiation circuits.

RTCBs

Each set of ~~RTSGs~~ is operated by either a manual reactor trip switch or an interposing relay actuated by RPS. There are four manual trip switches, arranged in two sets of two. Depressing both switches in either set will result in a reactor trip.

RTCB

When a manual trip is initiated using manual switches in the MCR, the RPS trip paths and relays are bypassed and the ~~RTSG~~ undervoltage and shunt trip devices are actuated independent of the RPS.

RTCBs

Manual trip circuitry includes the switches and interconnecting wiring to both ~~RTSGs~~ necessary to actuate both the undervoltage and shunt trip devices, but excludes the interposing relay contacts and their interconnecting wiring to the ~~RTSGs~~, which are considered part of the initiation circuit.

RTCBs

Functional testing of the entire RPS, from bistable logic input through the opening of individual sets of ~~RTSGs~~, can be performed either at power or shut down and is normally performed on a 31-day basis. DCD Tier 2, Section 7.2 (Reference 6), explains RPS testing in more detail.

APPLICABLE SAFETY ANALYSES

Design Basis Definition

The RPS is designed to ensure that the following operational criteria are met:

a. The associated actuation will occur when the monitored parameter reaches its setpoint and specific coincidence logic is satisfied.

b. Separation and redundancy are maintained to permit a channel to be out of service for testing or maintenance while still maintaining redundancy within the RPS instrumentation network.

BASES

APPLICABLE SAFETY ANALYSES (continued)

Each of the analyzed accidents and transients can be detected by one or more RPS functions. The accident analysis takes credit for most of the RPS trip functions. Those function for which no credit is taken, termed equipment protective functions, are not needed from a safety perspective.

Each RPS setpoint is chosen to be consistent with the Function of the respective trip. The basis for each trip setpoint falls into one of three general categories:

Category 1: To ensure SLs are not exceeded during AOOs

Category 2: To assist the ESFAS during accidents

Category 3: To prevent material damage to major plant components (equipment protective)

The RPS maintains the SLs during AOOs and mitigates the consequences of DBAs in all MODES in which the ~~RTSGs~~ RTCBs are closed.

The specific safety analysis applicable to each protective function is identified below:

1. Variable Overpower – High

The Variable Overpower – High trip provides protection against core damage during the following events:

- Uncontrolled CEA Withdrawal from Low Power (AOO)
- Uncontrolled CEA Withdrawal at Power (AOO)
- CEA Ejection (Accident)

BASES

APPLICABLE SAFETY ANALYSES (continued)

2. Logarithmic Power Level – High

The Logarithmic Power Level-High trip protects the integrity of the fuel cladding and helps protect the RCPB in the event of an unplanned criticality from a shutdown condition.

RTCBs

In MODES 2, 3, 4, and 5, with the ~~RTSGs~~ closed and the CEA drive system capable of CEA withdrawal, protection is required for CEA withdrawal events originating when THERMAL POWER is less than 10^{-3} % RTP. For events originating above this power level, other trips provide adequate protection.

RTCBs

MODES 3, 4, and 5, with the ~~RTSGs~~ closed, are addressed in LCO 3.3.2, "Reactor Protection System (RPS) Instrumentation – Shutdown."

RTCBs

In MODES 3, 4, or 5, with the ~~RTSGs~~ open or the CEAs not capable of withdrawal, the Logarithmic Power Level – High trip does not have to be OPERABLE. The indication and alarm Functions are addressed in LCO 3.3.13, "Logarithmic Power Monitoring Channels."

3. Pressurizer Pressure – High

The Pressurizer Pressure – High trip provides protection for the high RCS pressure SL. In conjunction with the pressurizer safety valves and the main steam pilot operated safety relief valve (POSRV), it provides protection against overpressurization of the RCPB during the following events:

- Loss of electrical load without a reactor trip being generated by the turbine trip (AOO)
- Loss of condenser vacuum (AOO)
- CEA withdrawal from low power conditions (AOO)
- Chemical and volume control system malfunction (AOO)
- Main feedwater system pipe break (accident)

BASES

LCO (continued)

Only the Allowable Values are specified for each RPS trip Function in the SCP. The nominal setpoints are selected to ensure the setpoints measured by CHANNEL FUNCTIONAL TESTS do not exceed the Allowable Value, if the channel is performing as required. Operation with a trip setpoint less conservative than the nominal trip setpoint, but within its Allowable Value, is acceptable provided that operation and testing are consistent with the assumptions of the plant specific setpoint calculations. A channel is inoperable if its actual trip setpoint is not within its required allowable value. Each Allowable Value specified is set accounting for instrument uncertainties appropriate to the trip function from the analytical limit assumed in the safety analysis.

The Bases for the individual function requirements are as follows:

1. Variable Overpower – High

This LCO requires four channels of Variable Overpower – High to be OPERABLE in MODES 1 and 2.

The variable over power trip signal initiates a reactor trip when the indicated neutron flux power increases at a rate greater than a predetermined value or reaches a high preset value.

The flux signal to be used is the average of three linear subchannel flux signals originating from excore neutron flux monitoring system (ENFMS).

2. Logarithmic Power Level – High

This LCO requires all four channels of the Logarithmic Power Level – High to be OPERABLE in MODE 2, and in MODE 3, 4, or 5 when the ~~RTSGs~~ RTCBs are closed and the CEA drive system is capable of CEA withdrawal.

The MODES 3, 4, and 5 Condition is addressed in LCO 3.3.2.

The Allowable Value is high enough to provide an operating envelope that prevents unnecessary Logarithmic Power Level – High reactor trips during normal plant operations. The Allowable Value is low enough for the system to maintain a margin to unacceptable fuel cladding damage should a CEA withdrawal event occur.

BASES

APPLICABILITY

Most RPS trips are required to be OPERABLE in MODES 1 and 2 because the reactor is critical in these MODES. The reactor trips are designed to take the reactor subcritical, which maintains the SLs during AOOs and assists the ESFAS in providing acceptable consequences during accidents. Most trips are not required to be OPERABLE in MODES 3, 4, and 5. In MODES 3, 4, and 5, the emphasis is placed on return to power events. The reactor is protected in these MODES by ensuring adequate SDM. Exception to this are:

RTCBs

The Logarithmic Power Level – High trip, RPS Logic ~~RTSGs~~, and manual trip are required in MODES 3, 4, and 5, with the ~~RTSGs~~ closed, to provide protection for boron dilution and CEA withdrawal events.

RTCBs

The Logarithmic Power Level – High trip in these lower MODES is addressed in LCO 3.3.2. The Logarithmic Power Level – High trip is bypassed prior to MODE 1 entry and is not required in MODE 1. The RPS Logic in MODES 1, 2, 3, 4 and 5 is addressed in LCO 3.3.4.

ACTIONS

The most common causes of channel inoperability are outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by the plant specific setpoint analysis. Typically, the drift is found to be small and results in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CHANNEL FUNCTIONAL TEST when the process instrument is set up for adjustment to bring it to within specification. If the trip setpoint is less conservative than the Allowable Value in SCP, the channel is declared inoperable immediately and the appropriate Conditions must be entered immediately.

In the event a channel's trip setpoint is found non-conservative with respect to the Allowable Value or the transmitter, instrument loop, signal processing electronics, or RPS bistable trip unit is found inoperable, then all affected functions provided by that channel must be declared inoperable and the unit must enter the Condition for the particular protection Function affected.

When the number of inoperable channels in a trip Function exceeds that specified in any related Condition associated with the same trip Function, then the plant is outside the safety analysis. Therefore, LCO 3.0.3 is immediately entered, if applicable in the current MODE of operation.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.6

The three vertically mounted excore nuclear instrumentation detectors in each channel are used to determine axial power distribution (APD) for use in the DNBR and LPD calculations. Because the detectors are mounted outside the reactor vessel, a portion of the signal from each detector is from core sections not adjacent to the detector. This is termed shape annealing and is compensated for after every refueling by performing SR 3.3.1.11, which adjusts the gains of the three detector amplifiers for shape annealing. SR 3.3.1.6 ensures that the pre-assigned gains are still proper. Power must be greater than or equal to 15% RTP because the CPCs do not use the excore generated signals for axial flux shape information at low power levels.

The Note allowing 12 hours after reaching 15% RTP is required for plant stabilization and testing.

The 31-day Frequency is adequate because the demonstrated long term drift of the instrument channels is minimal.

SR 3.3.1.7

A CHANNEL FUNCTIONAL TEST on each channel is performed every 31 days to ensure the entire channels will perform its intended function when needed. The SR is modified by a Note. The Note allows the CHANNEL FUNCTIONAL TEST for the Logarithmic Power Level – High channels to be performed 2 hours after logarithmic power drops below 10^{-3} % and is required to be performed only ~~RTSGs~~ are closed.

RTCBs

The RPS CHANNEL FUNCTIONAL TEST consists of overlapping tests as described in DCD TIER 2, Section 7.2 (Reference 6). These tests verify that the RPS is capable of performing its intended function from bistable input through the ~~RTSGs~~. They include:

RTCBs

Bistable Logic Tests

Bistable logic tests are performed to confirm that bistable logics are properly operating.

BASES

SURVEILLANCE REQUIREMENTS (continued)

Local Coincidence Logic Tests

Local coincidence logic tests are described in LCO 3.3.4.
Local coincidence logic tests are performed to confirm the operability of two-out-of-four logic and trip channel bypass logic.

Trip Path Tests

Trip path (initiation logic) tests are described in LCO 3.3.4. Initiation logic tests composed of selective two-out-of-four are performed after local coincidence logic tests are completed. These tests are performed only for one channel and one initiation logic.

RTCB

The ~~RTSG~~ test is a manually initiated test. The test is manually initiated because the test philosophy requires operator involvement in the testing and reclosing of these important reactor trip devices. The operator can obtain status information from the breaker open/close indication and current monitors and thus determine the success or failure of the test.

RTCBs

The ~~RTSGs~~ must then be closed prior to testing the other three initiation circuits or a reactor trip could result.

The CPC and CEAC channels and excore nuclear instrumentation channels are tested separately.

The excore channels use pre-assigned test signals to verify proper channel alignment. The excore logarithmic channel test signal is inserted into the preamplifier input, so as to test the first active element downstream of the detector.

The linear range excore test signal is inserted at the drawer input, since there is no preamplifier.

The CPC CHANNEL FUNCTIONAL TEST is performed every 31 days to check system operation status using MTP. The CPCS CHANNEL FUNCTIONAL TEST including trip function is performed every 18 months according to SR 3.3.1.10. The note is added to check each operable CPC have exact addressable constants in the CPCS CHANNEL FUNCTIONAL TEST.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.12

SR 3.3.1.12 is a CHANNEL FUNCTIONAL TEST similar to SR 3.3.1.7 is applicable only to automatic operating bypass functions and is performed once within 31 days prior to each startup. Proper operation by operating bypass permissive is critical during plant startup because the operating bypass must be in place to allow startup operation and must be automatically removed at the appropriate points during power ascent to enable certain reactor trips.

Consequently, the appropriate time to verify bypass removal function OPERABILITY is just prior to startup.
Once the operating bypasses are removed, the bypasses must not fail in such a way that the associated trip function gets inadvertently bypassed. This feature is verified by the trip function CHANNEL FUNCTIONAL TEST, SR 3.3.1.7. Therefore, further testing of the bypass removal function after startup is unnecessary.

SR 3.3.1.13

This SR ensures that the RPS RESPONSE TIMES are verified to be less than or equal to the maximum values assumed in the safety analysis. Individual component response times are not modeled in the analyses. The analyses model the overall or total elapsed time, from the point at which the parameter exceeds the trip setpoint value at the sensor to the point at which the ~~RTSGs~~ RTCBs open. Response times are conducted on an 18-month STAGGERED TEST BASIS. This results in the interval between successive surveillances of a given channel of n × 18 months, where n is the number of channels in the function. The Frequency of 18 months is based upon operating experience, which has shown that random failures or instrumentation components causing serious response time degradation, but not channel failure at power, are infrequent occurrences. Also, response times cannot be determined at power, since equipment operation is required. Testing may be performed in one measurement or in overlapping segments, with verification that all components are tested.

A Note is added to indicate that the excore neutron detectors may be excluded from RPS RESPONSE TIME testing because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Slow changes in detector sensitivity are compensated for by performing the daily calorimetric calibration (SR 3.3.1.4).

BASES

BACKGROUND (continued)

The reactor trip system (RTS) is a safety system which initiates reactor trips. The RTS consists of four channels of sensors, auxiliary process cabinet-safety (APC-S) cabinets, excore neutron flux monitoring system (ENFMS) cabinets, core protection calculator system (CPCS) cabinets, the reactor protection system (RPS) portion of plant protection system (PPS) cabinets, and reactor trip switchgear system (RTSS) cabinets as shown in Figure 7.2-1.

Different accident categories allow a different fraction of these limits based on probability of occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The RPS function is performed through the below portions in the RTS.

a. Measurement channels

b. Bistable logics

c. RPS logic

d. Reactor trip ~~switchgears (RTSGs)~~

circuit breakers (RTCBs)

RTCBs

This LCO applies only to the Logarithmic Power Level – High trip in MODES 3, 4, and 5 with the ~~RTSGs~~ closed. In MODES 1 and 2, this trip Function is addressed in LCO 3.3.1, “Reactor Protection System (RPS) Instrumentation – Operating.” LCO 3.3.13, “Logarithmic Power Monitoring Channels,” applies when the ~~RTSGs~~ are open. In the case of LCO 3.3.13, the logarithmic channels are required for monitoring neutron flux, although the trip Function is not required.

RTCBs

Measurement Channels and Bistable Logic

The measurement channels providing input to the Logarithmic Power Level – High trip consist of the four logarithmic nuclear instrumentation channels detecting neutron flux leakage from the reactor vessel. Other aspects of the Logarithmic Power Level – High trip are similar to the other measurement channels and bistables. These are addressed in the Background section of LCO 3.3.1.

BASES

APPLICABLE SAFETY ANALYSES

Functional testing of the entire RPS, from bistable input through the opening of individual sets of ~~RTSGs~~ RTCBs, can be performed either at power or shut down and is normally performed on a 31-day basis. Nuclear instrumentation can be similarly tested. DCD Tier 2, Section 7.2 (Reference 3), provides more detail on RPS testing.

The RPS functions to maintain the SLs during AOOs and mitigates the consequence of DBAs in all MODES in which the ~~RTSGs~~ RTCBs are closed. Each of the analyzed transients and accidents can be detected by one or more RPS Functions. The Logarithmic Power Level - High trip protects the integrity ofthe fuel cladding and helps protect the RCPB in the event of an unplanned criticality from a shutdown condition.

In MODES 2, 3, 4, and 5, with the ~~RTSGs~~ RTCBs closed and the control element assembly (CEA) drive system capable of CEA withdrawal, protection is required for CEA withdrawal events originating when logarithmic power is less than 10^{-3} %. For events originating above this power level, other trips provide adequate protection.

MODES 3, 4, and 5, with the RTCBs closed, are addressed in this LCO. MODE 2 is addressed in LCO 3.3.1.

In MODES 3, 4, or 5, with the ~~RTSGs~~ RTCBs open or the CEAs not capable of withdrawal, the Logarithmic Power Level – High trip does not have to be OPERABLE. However, the indication and alarm portion of two logarithmic channels must be OPERABLE to ensure proper indication of neutron population and to indicate a boron dilution event. The indication and alarm functions are addressed in LCO 3.3.13.

The bypasses and their Allowable Values are addressed in SCP. The automatic operating bypass removal features must function as a backup to manual actions for all safety related trips to ensure the trip functions are not operationally bypassed when the safety analysis assumes the functions are not bypassed. The operating bypass for Logarithmic Power Level – High is described in Table 3.3.2-1.

The RPS satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires the Logarithmic Power Level – High RPS Function to be OPERABLE. Failure of any required portion of the instrument channel renders the affected channel inoperable and reduces the reliability of the affected Function.

BASES

LCO (continued)

Bypassing the same parameter in more than one channel is restricted by the administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. All-bypass function for bypassing all parameters in the channel is interlocked in LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass interlock is implemented based on analog circuit through hardwired cable between LCLs in all channels. The purpose of all-bypass function is to support testing and maintenance of BP whereas the trip channel bypass is used against sensor failure. With one channel in each Function trip channel bypassed, this effectively places the plant in a two- out-of-three logic configuration in those Functions. Plants are restricted to 48 hours in a trip channel bypass condition before either restoring the function to four channel operation (two-out-of-four logic) or placing the channel in trip (one-out-of-three logic).

This LCO requires all four channels of the Logarithmic Power Level – High to be OPERABLE in MODE 2, and in MODE 3, 4, or 5 when the ~~RTSGs~~ RTCBs are closed and the CEA drive system is capable of CEA withdrawal.

The Allowable Value specified in the Setpoint Control Program (SCP) is high enough to provide an operating envelope that prevents unnecessary Logarithmic Power Level – High reactor trips during normal plant operations. The Allowable Value is low enough for the system to maintain a safety margin for unacceptable fuel cladding damage should a CEA withdrawal event occur.

The Logarithmic Power Level – High trip may be bypassed when logarithmic power is above 10^{-3} % to allow the reactor to be brought to power during a reactor startup. This bypass is automatically removed when logarithmic power decreases below 10^{-3} %. Above 10^{-3} %, the Linear Power Level – High and Pressurizer Pressure – High trips provide protection for reactivity transients.

The trip may be manually bypassed during physics testing pursuant to LCO 3.1.10, “Special Test Exception (STE) – Shutdown Margin (SDM).” During this testing, the Linear Power Level – High trip and administrative controls provide the required protection.

BASES

APPLICABILITY

Most RPS trips are required to be OPERABLE in MODES 1 and 2 because the reactor is critical in these MODES. The trips are designed to take the reactor subcritical, which maintains the SLs during AOOs and assists the engineered safety features actuation system (ESFAS) in providing acceptable consequences during accidents.

Most trips are not required to be OPERABLE in MODES 3, 4, and 5. In MODES 3, 4, and 5, the emphasis is placed on return to power events. The reactor is protected in these MODES by ensuring adequate SDM. Exceptions to this are:

a. The Logarithmic Power Level – High trip, RPS Logic ~~RTSGs~~, and Manual Trip are required in MODES 3, 4, and 5, with the ~~RTSGs~~ closed, to provide protection for boron dilution and CEA withdrawal events. The Logarithmic Power Level – High trip in these lower MODES is addressed in this LCO. The RPS Logic in MODES 1, 2, 3, 4, and 5 is addressed in LCO 3.3.4, “Reactor Protection System (RPS) Logic and Trip Initiation.”

RTCBs

RTCBs

b. The Steam Generator #1 Pressure – Low trip, Steam Generator #2 Pressure – Low trip, RPS Logic, ~~RTSGs~~ and manual trip are required in MODES 3 and 4, with the ~~RTSGs~~ closed, to provide protection for MSLB. The Steam Generator Pressure – Low trip in shutdown MODE is described in LCO.

RTCBs

RTCBs

c. The Applicability is modified by a Note that allows the trip to be bypassed when logarithmic power is greater than or equal to 1×10^{-3} %, and the bypass is automatically removed when logarithmic power is less than 1×10^{-3} %.

The most common causes of channel inoperability are outright failure or drift of the bistable or process module sufficient to exceed the tolerance allowed by the plant specific setpoint analysis. Typically, the drift is found to be small and results in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CHANNEL FUNCTIONAL TEST when the process instrument is set up for adjustment to bring it to within specification. If the trip setpoint is less conservative than the Allowable Value stated in the SCP, the channel is declared inoperable immediately, and the appropriate Condition(s) must be entered immediately.

In the event a channel's trip setpoint is found nonconservative with respect to the Allowable Value, or the excore logarithmic power channel or RPS bistable trip unit is found inoperable, then all affected Functions provided by that channel must be declared inoperable and the unit must enter the Condition for the particular protection Function affected.

BASES

ACTIONS (continued)

D.1 and D.2

Condition D applies to two inoperable automatic bypass removal channels. If the bypass removal channels for two operating bypasses cannot be restored to OPERABLE status within 1 hour, the associated RPS channel may be considered OPERABLE only if the bypass is not in effect. Otherwise, the affected RPS channels must be declared inoperable, as in Condition B, and the bypass either removed or one automatic trip channel placed in bypass and the other in trip within 1 hour. The restoration of one affected bypassed automatic trip channel must be completed prior to the next CHANNEL FUNCTIONAL TEST or the plant must shut down per LCO 3.0.3, as explained in Condition B. Completion Times are consistent with Condition B.

E.1

Condition E is entered when the Required Actions and associated Completion Times of Condition A, B, C, or D are not met.

RTCBs

If Required Actions associated with these Conditions cannot be completed within the required Completion Time, all ~~RTSGs~~ must be opened, placing the plant in a condition where the logarithmic power trip channels are not required to be OPERABLE. A Completion Time of 1 hour is a reasonable time to perform the Required Action, which maintains the risk at an acceptable level while having one or two channels inoperable.

SURVEILLANCE REQUIREMENTS

The SRs for the Logarithmic Power Level – High trip are an extension of those listed in LCO 3.3.1, listed here because of their Applicability in these MODES.

SR 3.3.2.1

SR 3.3.2.1 is the performance of a CHANNEL CHECK of each logarithmic power channel. This SR is identical to SR 3.3.1.1. Only the Applicability differs.

Performance of the CHANNEL CHECK once every 12 hours ensures that gross failure of instrumentation has not occurred.

BASES

SURVEILLANCE REQUIREMENTS (continued)

A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on another channel.

It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying that the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability. If a channel is outside the criteria, it could be an indication that the sensor or the signal processing equipment has drifted outside its limits.

The Frequency, about once every shift, is based on operating experience that demonstrates the rarity of channel failure. Since the probability of two random failures in redundant channels in any 12 hour period is extremely low, the CHANNEL CHECK minimizes the chance of loss of protection function due to failure of redundant channels. The CHANNEL CHECK supplements less formal, but more frequent, checks of channel OPERABILITY during normal operational use of the displays associated with the LCO required channels.

SR 3.3.2.2

A CHANNEL FUNCTIONAL TEST on each channel is performed every 31 days to ensure the entire channel will perform its intended function when needed. This SR is identical to SR 3.3.1.7. Only the Applicability differs. The RPS CHANNEL FUNCTIONAL TEST consists of three overlapping tests as described in DCD Tier 2, Section 7.2 (Reference 3). These tests verify that the RPS is capable of performing its intended function, from bistable input through the ~~RTSGs~~. They include:

BASES

SURVEILLANCE REQUIREMENTS (continued)

Bistable Logic Tests

A test signal is superimposed on the input in one channel at a time to verify that the bistable trips within the specified tolerance around the setpoint. This is done with the affected RPS channel trip channel bypassed.

The SCP has controls which require verification that the instrument channel functions as required by verifying the as-left and as- found setting are consistent with those established by the setpoint methodology.

Local Coincidence Logic Tests

Local coincidence logic tests are addressed in LCO 3.3.4. Local coincidence logic tests are performed to confirm the operability of two-out-of-four logic and trip channel bypass logic.

Trip Path Test

Trip path (initiation logic) tests are described in LCO 3.3.4.

Initiation logic tests composed of two-out-of-four are performed after local coincidence logic tests are completed. These tests are performed only for one channel and one initiation logic.

RTCB

The ~~RTSG~~ test is a manually initiated test. The test is manually initiated because the test philosophy requires operator involvement in the testing and reclosing of these important reactor trip devices. The operator can obtain status information from the breaker open/close indication and current monitors and thus determine the success or failure of the test. The ~~RTSGs~~ must then be closed prior to testing the other three initiation circuits, or a reactor trip could result.

RTCBs

The excore channels use pre-assigned test signals to verify proper channel alignment. The excore logarithmic channel test signal is inserted into the preamplifier input, so as to test the first active element downstream of the detector.

BASES

BACKGROUND (continued)

The RPS function is performed through the portions below in the reactor trip system (RTS).

a. Measurement channels

b. Bistable logics

c. RPS logic

d. ~~RTSG~~ ← RTCB

This LCO addresses the CEACs. LCO 3.3.1 provides a description of this equipment in the RPS.

The CEACs are considered components in the measurement channels of the DNBR-Low and LPD-High trips. The CEACs are addressed by this LCO.

Each CPC receives CEA deviation penalty factors from both CEACs in that channel and uses the larger of the penalty factors from the two CEACs in the calculation of DNBR and LPD. CPCs are further described in the Background section of LCO 3.3.1.

The CEACs perform the calculations required to determine the position of CEAs within their subgroups for the CPCs. Two independent CEACs in each CPCS channel compare the position of each CEA to its subgroup position. If a deviation is detected by either CEAC, an alarm occurs and appropriate “penalty factors” are transmitted to the associated the CPC processor in that channel. These penalty factors conservatively adjust the effective operating margins to the DNBR – Low and LPD – High trips.

Each CEA has two separate reed switch position transmitter (RSPT) assemblies mounted outside the RCPB, designated RSPT1 and RSPT2. CEA position from the RSPTs is processed by CEA position processors (CPPs) located in each CPCS channel. The CPPs transmit CEA position to the appropriate CEAC in all four CPCS channels over optically isolated datalinks, such that CEAC1 in all channels receives the position of all CEAs based upon RSPT1, and CEAC2 receives the position of all CEAs based upon RSPT2. Thus, the position of all CEAs is independently monitored by both CEACs in each CPCS channel.

BASES

BACKGROUND (continued)

Different accident categories allow a different fraction of these limits based on probability of occurrence. Meeting the acceptable dose limit for an accident category is considered having acceptable consequences for that event.

The reactor trip system (RTS) is a safety system which initiates reactor trips. The RTS consists of four channels of sensors, auxiliary process cabinet-safety (APC-S) cabinets, excore neutron flux monitoring system (ENFMS) cabinets, core protection calculator system (CPCS) cabinets, the reactor protection system (RPS) portion of plant protection system (PPS) cabinets, and reactor trip switchgear system (RTSS) cabinets.

The RPS function is performed through the below portions in the RTS.

a. Measurement channels

b. Bistable logics

c. RPS logic

d. ~~RTSG~~

Reactor trip circuit breakers (RTCBs)

RTCBs

This LCO addresses the RPS logic and ~~RTSGs~~, including manual trip capability. Measurement channels and bistable logics are described in LCO 3.3.1, “Reactor Protection System (RPS) Instrumentation – Operating.” LCO 3.3.1 provides a description of the role of this equipment in the RPS. This is summarized below:

RPS Logic

The RPS logic consists of both local coincidence and initiation logic includes watchdog timer monitoring the heartbeat signal of LCL processor located in initiation circuit. The RPS logic employs a scheme that provides a reactor trip when bistables in any two of the four channels sense the same input parameter trip. This is called a two-out-of-four trip logic.

Each LCL receives four trip signals, one from its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. The LCL also receives the trip channel bypass status associated with each of the above mentioned bistables. The function of the LCL is to generate a coincidence signal whenever two or more like bistables are in a tripped condition.

BASES

BACKGROUND (continued)

The LCL takes into consideration the trip bypass input state when determining the coincidence logics state. Designating the protection channels as A, B, C, D, with no trip bypass present, the LCL will produce a coincidence signal for any of the following trip inputs: AB, AC, AD, BC, BD, CD, ABC, ABD, ACD, BCD, ABCD. These represent all possible two- or more out-of-four trip combinations of the four protection channels. Should a trip bypass be present, the logic will provide a coincidence signal when two or more of the three un-bypassed bistables are in a tripped condition.

On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state.

In addition to a coincidence signal, each LCL also provides bypass status outputs. The bypass status is provided to verify that a bypass has actually been entered into the logic either locally or remotely via the maintenance and test panel or the operator's module.

The inputs to the initiation logic are the LCL outputs from the appropriate LCLs. The LCL outputs are arranged in the initiation circuit to provide selective two-out-of-four coincidence. This configuration will avoid spurious channel initiation in the event of a single LCL processor or digital output module failure.

The RPS initiation logic consists of an "OR" circuit for each undervoltage and de-energizes interposing relays. Each interposing relay opens one ~~switchgear in RTSG~~ RTCB in turn.

It is possible to change the two-out-of-four RPS logic to a two-out-of-three logic for a given input parameter in one channel at a time by trip channel bypassing.

BASES

BACKGROUND (continued)

Thus, the bistable logic will function normally, producing normal trip indication and annunciation, but a reactor trip will not occur unless two additional channels indicate a trip condition. Trip channel bypassing can be simultaneously performed on any number of parameters in any number of channels, providing each parameter is bypassed in only one channel at a time. Bypassing the same parameter in more than one channel is restricted by the administrative procedure. The coincidence logic becomes 2-out-of-3 coincidence logic. All-bypass function for bypassing all parameters in the channel is interlocked in LCL algorithm to prevent simultaneous bypass of more than one channel. The all-bypass interlock is implemented based on analog circuit through hardwired cable between LCLs in all channels. The purpose of all-bypass function is to support testing and maintenance of BP whereas the trip channel bypass is used for sensor failure.

RTCB

~~RTSG~~

RTCBs

RTCB

The reactor trip switchgear consists of eight ~~RTSGs~~. Power input to the ~~RTSG~~ comes from two full capacity MG sets operated in parallel, such that the loss of either MG set does not de-energize the CEDMs. Both trip legs shall be interrupted to drop CEAs and two separate methods shall be provided because each power is connected to only one of two ~~RTSGs~~ connected in serial. The two ~~RTSGs~~ within a trip leg are actuated by separate initiation circuits. When two CEDM power supply buses are lost, all CEAs will fall into the core by gravity. The PPS interfaces with the undervoltage trip device of RTSS breakers. The DPS interfaces with the shunt trip device of the RTSS breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs).

RTCBs

RTCBs

RTCBs

Each set of ~~RTSG~~ is operated by either a manual reactor trip switch or an interposing relay actuated by RPS. There are four manual trip switches, arranged in two sets of two. Depressing both switches in either set will result in a reactor trip. When a manual trip is initiated using manual switches in MCR, the RPS trip paths and relays are bypassed, and the ~~RTSG~~ undervoltage and shunt trip devices are actuated independent of the RPS.

RTCB

RTCBs

Manual trip circuitry includes the switches and interconnecting wiring to both ~~RTSGs~~ necessary to actuate both the undervoltage and shunt trip devices but excludes the interposing relay contacts and their interconnecting wiring to the ~~RTSGs~~, which are considered part of the initiation circuit.

RTCBs

BASES

BACKGROUND (continued)

RTCBs

Functional testing of the entire RPS, from bistable logic input through the opening of individual sets of ~~RTSGs~~, can be performed either at power or shut down and is normally performed on a 31-day basis. DCD Tier 2, Section 7.2 (Reference 3), explains RPS testing in more detail.

Reactor Protection System (RPS) Logic

The RPS logic provides for automatic trip initiation to maintain the SLs during AOOs and assist the ESF systems in ensuring acceptable consequences during accidents. All transients and accidents that call for a reactor trip assume the RPS logic is functioning as designed.

APPLICABLE SAFETY ANALYSES

Reactor Trip ~~Switchgears (RTSGs)~~ Circuit Breakers (RTCBs)

All of the transient and accident analyses that call for a reactor trip assume that the ~~RTSGs~~ operate and interrupt power to the CEDMs.

Manual Trip

RTCBs

There are no accident analyses that take credit for the manual trip; however, the manual trip is part of the RPS circuitry. It is used by the operator to shut down the reactor whenever any parameter is rapidly trending toward its trip setpoint. A manual trip accomplishes the same results as any one of the automatic trip functions.

LCO

Reactor Protection System (RPS) Logic

The LCO on the RPS logic channels ensures that each of the following requirements are met:

a. A reactor trip will be initiated when necessary.

b. The required protection system coincidence logic is maintained (minimum two-out-of-three, normal two-out-of-four).

c. Sufficient redundancy is maintained to permit a channel to be out of service for testing or maintenance.

Failures of individual bistable logics are addressed in LCO 3.3.1.

BASES

LCO (continued)

This Technical Specification (TS) addresses failures of the RPS logic not addressed in the above, such as the failure of LCL power supplies or the failure of the trip channel bypass in the bypass condition.

RTCBs

RTCB

Loss of a single vital bus will de-energize one of the power supplies in each LCL Channel. This will result in two ~~RTSG~~ opening. However, the remaining six closed ~~RTSGs~~ will prevent a reactor trip. For the purposes of this LCO, de-energizing up to the affected channel power supplies due to a single failure is to be treated as a single channel failure, providing the affected coincidence logic operates as designed and opens the affected ~~RTSGs~~.

RTCBs

Each LCL receives four trip signals, one from its associated bistable logic in the channel and one from each of the equivalent bistable logic located in the other three channels. On a system basis, a coincidence signal is generated in all four protection channels whenever a coincidence of two or more like bistables of the four channels are in a tripped state. The inputs to the initiation logic are the LCL outputs from the appropriate LCLs. The LCL outputs are arranged in the initiation circuit to provide selective two-out-of-four coincidence. The reactor protection system initiation logic consists of an “OR” circuit for each undervoltage relay and de-energizes interposing relays. Each interposing relay opens one ~~switchgear in RTSG~~ in turn.

RTCB

If a coincidence logic power supply or vital instrument bus in a channel fails, two interposing relays in the affected channel are de-energized. This will result in opening the affected ~~RTSG~~.

RTCB

RTCB

If two ~~RTSGs~~ in a channel have been opened in response to a single ~~RTSG~~ channel, initiation logic channel, or manual trip channel failure, the affected ~~RTSG~~ may be closed for up to 1 hour for Surveillance on the initiation logic channel, ~~RTSG~~, and manual trip channels. In this case, the redundant ~~RTSG~~ will provide protection if a trip should be required.

RTCB

RTCB

RTCB

RTCB

1. Coincidence Logic

This LCO requires four coincidence logic channels to be OPERABLE in MODES 1 and 2, and in MODES 3, 4, and 5 when the ~~RTSGs~~ are closed and any CEA is capable of being withdrawn.

RTCBs

BASES

LCO (continued)

2. Initiation Logic

This LCO requires four initiation logic channels to be OPERABLE in MODES 1 and 2, and in MODES 3, 4, and 5 when the ~~RTSGs~~ are closed and any CEA is capable of being withdrawn.

RTCBs

RTCB

3. ~~RTSG~~

RTCB

The LCO requires four ~~RTSG~~ channels to be OPERABLE in MODES 1 and 2, and in MODES 3, 4, and 5 when the ~~RTSGs~~ are closed and any CEA is capable of being withdrawn.

RTCBs

RTCBs

Each channel of ~~RTSGs~~ starts at the interposing relay contact and the manual trip contact for each breaker. Manual trip contacts and upstream circuitry are considered to be manual trip circuitry.

RTCB

RTCB

A Note associated with the ACTIONS states that if one ~~RTSG~~ has been opened in response to a single ~~RTSG~~ channel, initiation logic channel, or manual trip channel failure, the affected ~~RTSG~~ may be closed for up to 1 hour for Surveillance on the OPERABLE initiation logic, ~~RTSG~~, and manual trip channels.

RTCB

RTCB

4. Manual Trip

The LCO requires all four manual trip channels to be OPERABLE in MODES 1 and 2, and MODES 3, 4, and 5 when the ~~RTSGs~~ are closed and any CEA is capable of being withdrawn.

RTCBs

RTCBs

Two independent sets of two adjacent switches are provided at separate locations. Each switch is considered a channel and operates two of the eight ~~RTSGs~~. Depressing both push switches in either set will cause an interruption of power to the CEDMs, allowing the CEAs to fall into the core. This design ensures that no single failure in any push switch circuit can either cause or prevent a reactor trip.

RTCB

Manual trip switches are also provided at the ~~RTSG~~ (locally) in case the main control room (MCR) push buttons become inoperable or the MCR becomes uninhabitable. These are not part of the RPS and cannot be credited in fulfilling the LCO operability requirements. Furthermore, LCO 3.3.4 ACTIONS need not be entered due to failure of a local manual trip.

BASES

APPLICABILITY

The RPS logic channels (coincidence logic, initiation logic), ~~RTSGs~~, and manual trip channels are required to be OPERABLE in MODE 1, 2 and MODES 3, 4, and 5 when the CEAs are capable of being withdrawn and ~~RTSGs~~ are closed. RPS instrument in MODES 1 and 2 is described in LCO 3.3.1. When the CEAs are capable of being withdrawn and ~~RTSGs~~ are closed, RPS instrument in MODES 3, 4, and 5 are described in LCO 3.3.2. CEAC in MODES 1 and 2 is described in LCO 3.3.3.

The RPS logic, ~~RTSGs~~, and manual trip are required to be OPERABLE in any MODE when any CEA is capable of being withdrawn from the core (i.e., ~~RTSGs~~ closed and power available to the CEDMs). This ensures the reactor can be tripped when necessary, but allows for maintenance and testing when the reactor trip is not needed.

In MODES 3, 4, and 5 with all the ~~RTSGs~~ open, the CEAs are not capable of withdrawal and these Functions do not have to be OPERABLE.

However, two logarithmic power level channels must be OPERABLE to ensure proper indication of neutron population and indicate a boron dilution event. This is addressed in LCO 3.3.14, “Boron Dilution Alarm.”

ACTIONS

When the number of inoperable channels in a trip Function exceeds that specified in any related Condition associated with the same trip Function, then the plant is outside the safety analysis. Therefore, LCO 3.0.3 is immediately entered if applicable in the current MODE of operation.

A.1

Condition A applies to one coincidence logic channel, one initiation logic channel, ~~RTSG~~ channel, or manual trip channel in MODES 1 and 2, since they have the same ACTIONS. MODES 3, 4, and 5, with the ~~RTSGs~~ closed, are addressed in Condition B. These Required Actions require opening the affected ~~RTSGs~~.

This removes the need for the affected channel by performing its associated safety function. With an ~~RTSG~~ open, the affected Functions are in 2-out-of-3 logic, which meets redundancy requirements, but testing on the OPERABLE channels cannot be performed without causing a reactor trip unless the ~~RTSGs~~ in the inoperable channels are closed to permit testing.

BASES

ACTIONS (continued)

RTCBs

Therefore, a Note has been added, specifying that the ~~RTSGs~~ associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST.

RTCBs

Required Action A.1 provides for opening the ~~RTSGs~~ associated with the inoperable channel within a Completion Time of 1 hour. This Required Action is conservative, since depressing the manual trip switch associated with either set of breakers in the other trip leg will cause a reactor trip. With this configuration, a single channel failure will not prevent a reactor trip. The allotted Completion Time is adequate for opening the affected ~~RTSGs~~ while maintaining the risk of having them closed at an acceptable level.

RTCBs

B.1

RTCBs

RTCB

Condition B applies to the failure of one initiation logic channel, ~~RTSG~~ channel, or manual trip channel affecting the same trip leg in MODE 3, 4, or 5 with the ~~RTSGs~~ closed. The channel must be restored to OPERABLE status within 48 hours. If the inoperable channel cannot be restored to OPERABLE status within 48 hours, the affected ~~RTSGs~~ must be opened so the affected functions are one-out-of-two logic which meets redundancy requirements.

RTCBs

The Completion Time of 48 hours is adequate to repair most failures.

RTCBs

Testing on the OPERABLE channels cannot be performed without causing a reactor trip, unless the ~~RTSGs~~ in the inoperable channels are closed to permit testing. Therefore, a Note has been added specifying that the ~~RTSGs~~ associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST.

RTCBs

C.1

RTCBs

Condition C applies to the failure of both initiation logic channels affecting the same trip leg. Since this will open two channels of ~~RTSGs~~, this Condition is also applicable to channels in the same trip leg. This will open both ~~RTSGs~~ in the affected trip leg, satisfying the Required Action of opening the affected ~~RTSGs~~.

RTCBs

BASES

ACTIONS (continued)

Of greater concern is the failure of the initiation circuit in a non-trip condition. With only one RPS logic channel failed in a non-trip condition, there is still the redundant set of ~~RTSGs~~ in the trip leg.

RTCBs

With both failed in a non-trip condition, the reactor will not trip automatically when required. In either case, the affected ~~RTSGs~~ must be opened immediately by using the appropriate manual trip push switches, since each of the four push buttons opens one ~~RTSG~~. Caution is required since reactor will be shut down by pushing unrelated switches.

RTCBs

RTCB

RTCB

If the affected ~~RTSG~~ cannot be opened, Required Action D is entered. This would only occur if there is a failure in the manual trip circuitry or the ~~RTSGs~~.

RTCBs

D.1 and D.2

Condition D is entered if Required Actions associated with Condition A or C are not met within the required Completion Time or if for one or more functions, more than one logic (coincidence logic, initiation logic), manual trip channel, or ~~RTSG~~ channel is inoperable for reasons other than Condition C.

RTCB

RTCBs

If the ~~RTSGs~~ associated with the inoperable channel cannot be opened, the reactor must be shut down within 6 hours and all the ~~RTSGs~~ opened. A Completion Time of 6 hours is reasonable, based on operating experience, for reaching the required plant conditions from full power conditions in an orderly manner and without challenging plant systems and for opening ~~RTSGs~~. All ~~RTSGs~~ should then be opened, placing the plant in a MODE where the LCO does not apply and ensuring no CEA withdrawal occurs.

RTCBs

RTCBs

RTCBs

SURVEILLANCE REQUIREMENTS

The OPERABILITY of the ITP is not limited per LCO 3.3.4 because ITP does not perform the safety function of RPS. However, the ITP shall maintain the functional integrity to perform CHANNEL FUNCTIONAL TEST of SR 3.3.4.1 and 3.3.4.2.

SR 3.3.4.1

A CHANNEL FUNCTIONAL TEST on each channel is performed every 31 days to ensure the entire channel will perform its intended function when needed.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The RPS CHANNEL FUNCTIONAL TEST consists of overlapping tests as described in DCD Tier 2, Section 7.2 (Reference 3). These tests verify that the RPS is capable of performing its intended function, from bistable input through the ~~RTSGs~~.

RTCBs

Bistable logic test is described in SR 3.3.1.7. This SR describes two kinds of test related to RPS logic which includes coincidence logic and trip path (initiation logic).

LCL Testing

Automatic LCL testing is performed to verify the operability of two-out-of-four logic and trip channel bypass logic.

Trip Path Testing

RTCB

The ~~RTSG~~ test is a manually initiated test. The test is manually initiated because the test philosophy requires operator involvement in the testing and reclosing of these important reactor trip devices. The operator can obtain status information from the breaker open/close indication and current monitors and thus determine the success or failure of the test. The ~~RTSGs~~ must then be closed prior to testing the other three initiation circuits, or a reactor trip could result.

RTCBs

SR 3.3.4.2

RTCBs

RTCB

Each ~~RTSG~~ is actuated by an undervoltage coil and a shunt trip coil. De-energizing the undervoltage coil or energizing the shunt trip coil will cause the circuit breaker to open. The PPS interfaces with the undervoltage trip device of ~~RTSS breakers~~. The DPS interfaces with the shunt trip device of the ~~RTSS breakers~~. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs). When an ~~RTSG~~ is opened, either during an automatic reactor trip or by using the manual push switches in the MCR, the undervoltage coil is de-energized and the shunt trip coil is energized. This makes it possible to determine if one of the coils or associated circuitry is defective.

RTCB

RTCBs

BASES

SURVEILLANCE REQUIREMENTS (continued)

Therefore, once every 18 months, a CHANNEL FUNCTIONAL TEST is performed, that individually tests all four sets of undervoltage coils and all four sets of shunt trip coils. During undervoltage coil testing, the shunt trip coils must remain de-energized, preventing their operation. Conversely, during shunt trip coil testing, the undervoltage coils must remain energized, preventing their operation.

RTCB

This Surveillance ensures that every undervoltage coil and every shunt trip coil is capable of performing its intended function, and that no single active failure of any ~~RTSC~~ component will prevent a reactor trip. The 18-month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillance when performed at the Frequency of once every 18 months.

SR 3.3.4.3

A CHANNEL FUNCTIONAL TEST on the manual trip channels is performed periodically once every 31 days to ensure the entire channel will perform its intended function if required.

REFERENCES

1. 10 CFR Part 50, Appendix A.
2. 10 CFR 50.34.
3. DCD Tier 2, Section 7.2.

B 3.3 INSTRUMENTATION

B 3.3.13 Logarithmic Power Monitoring Channels

BASES

BACKGROUND

The logarithmic power monitoring channels provide neutron flux power indication from less than 10^{-7} % RTP to greater than 100 % RTP. They also provide reactor protection when the reactor trip ~~switchgears (RTSGs)~~ circuit breakers (RTCBs) are shut, in the form of a Logarithmic Power Level – High trip.

This LCO addresses MODES 3, 4, and 5 with the ~~RTSGs~~ RTCBs open. When the ~~RTSGs~~ RTCBs are shut, the logarithmic power monitoring channels are addressed by LCO 3.3.2, “Reactor Protection System (RPS) Instrumentation – Shutdown.”

When the ~~RTSGs~~ RTCBs are open, two of the four logarithmic power monitoring channels must be available to monitor neutron flux power. In this application, the RPS channels need not be OPERABLE since the reactor trip Function is not required. By monitoring neutron flux (logarithmic) power when the ~~RTSGs~~ RTCBs are open, loss of SDM caused by boron dilution can be detected as an increase in flux. Alarms are also provided when power increases above the fixed bistable setpoints. Two channels must be OPERABLE to provide single failure protection and to facilitate detection of channel failure by providing CHANNEL CHECK capability.

APPLICABLE SAFETY ANALYSES

The logarithmic power monitoring channels are necessary to monitor core reactivity changes. They are one of the primary means for detecting and triggering operator actions to respond to reactivity transients initiated from conditions in which the RPS is not required to be OPERABLE. The logarithmic power monitoring channels also trigger operator actions to anticipate RPS actuation in the event of reactivity transients starting from shutdown or low power conditions. The logarithmic power monitoring channel’s LCO requirements support compliance with Reference 1. Reference 2 describes the specific logarithmic power monitoring channel features that are critical to comply with the GDC.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The OPERABILITY of logarithmic power monitoring channels is necessary to meet the assumption of the safety analyses and to provide for the mitigation of accident and transient conditions.

The logarithmic power monitoring channels satisfy LCO SELECTION CRITERION 3.

LCO

The LCO on the logarithmic power monitoring channels ensures that adequate information is available to verify core reactivity conditions while shut down.

A minimum of two logarithmic power monitoring channels are required to be OPERABLE.

APPLICABILITY

In MODES 3, 4, and 5, with ~~RTSGs~~ RTCBs open or the control element assembly (CEA) drive system not capable of CEA withdrawal, logarithmic power monitoring channels must be OPERABLE to monitor core power for reactivity changes. In MODES 1 and 2, and in MODES 3, 4, and 5, with the ~~RTSGs~~ RTCBs shut and the CEAs capable of withdrawal, the logarithmic power monitoring channels are addressed as part of the RPS in LCO 3.3.1, “Reactor Protection System Instrumentation – Operating,” and LCO 3.3.2, “Reactor Protection System Instrumentation – Shutdown.”

The requirements for startup range neutron flux monitoring in MODE 6 are addressed in LCO 3.9.2, "Nuclear Instrumentaion" The startup range nuclear monitoring channels provide neutron flux coverage extending an additional one to two decades below the logarithmic channels for use during refueling, when neutron flux could be extremely low.

ACTIONS

A channel is inoperable when it does not satisfy the OPERABILITY criteria for the channel's function. These criteria are outlined in the LCO section of the Bases.

A.1 and A.2

With one required channel inoperable, it may not be possible to perform a CHANNEL CHECK to verify that the other required channel is OPERABLE.

REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**239-8076**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**10/09/2015**

Question No. 16-99

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

The proposed ACTIONS Table for generic TS 3.3.1 contains the following differences from STS 3.3.1B that do not appear to be justified. The applicant is requested to conform to the STS phrasing and provisions, or justify the difference:

1. Required Action A.2 and associated Bases unnecessarily adds “trip” before “channel”; alternately, add trip to Required Action A.1.

2. Completion Time for required Actions A.2 and C.2.2 should match STS (“Prior to entering MODE 2 following next MODE 5 entry”); apply this change everywhere the Completion Time of "Prior to next entry into MODE 2 following entry into MODE 5" is used;

3. Condition B should match STS (“B. One or more Functions with two automatic RPS trip channels inoperable.”);

4. Conditions C and D should match STS, but also include “operating” as proposed (“C. One or more Functions with one automatic operating bypass removal channel inoperable.”), and (“D. One or more Functions with two automatic operating bypass removal channels inoperable.”);

5. The Note in generic TS 3.3.1 for Required Action B.1 (besides being misplaced) does not seem to be relevant to the action requirement. Remove the Note;

6. The logical connector between Required Actions C.2.1 and C.2.2 should align with the period before the last digit of the labels C.2.1 and C.2.2;

7. The Note in the Required Action column of Condition D, that states “LCO 3.0.4 is not applicable” with the unit in Condition D, is unnecessary, since the ACTIONS will permit operation to continue indefinitely with bypass removal channels disabled, or one channel in trip and one channel in bypass for affected RPS Function(s).

8. Required Actions C.1 and D.1, which say “Disable [automatic operating] bypass [removal] channel(s).” are unclear. Since the function being disabled is to automatically remove the bypass and enable the associated RPS trip channel, unbypassing the RPS trip channel would need to be done manually before reaching the reset setting. The applicant is requested to clarify the meaning of these action requirements.

Response – (Rev. 1)

The following changes will be made to TS 3.3.1 to be consistent with STS 3.3.1B:

1. The word “trip” will be added to Required Action A.1.

2. The completion time for Required Actions A.2 and C.2.2 will be changed to “Prior to entering MODE 2 following next MODE 5 entry.”

3. The phrase “automatic RPS” will be added in Condition B.

4. The word “automatic” will be added in Conditions C and D.

5. The Note described in the Required Action B.1 will be deleted. The associated statements described in Action B.1 of B 3.3.1 will be deleted.

6. The logical connector “AND” between Required Actions C.2.1 and C.2.2 will be aligned with the period before the last digit of the labels C.2.1 and C.2.2.

7. The Note described in the Required Action column of Condition D will be deleted. The associated statements described in Action D.1 of B 3.3.1 will be deleted.

8. Required Actions C.1, which states “Disable bypass channel” means that if the inoperable bypass removal function for any bypass channel cannot be restored to OPERABLE status within 1 hour, except for the case that the bypass is not in effect, the associated trip channel must be declared inoperable as stated in Condition A. Required Action D.1, which states “Disable bypass channels” means that if the inoperable bypass removal function for two bypass channels cannot be restored to OPERABLE status within 1 hour, except for the case that the bypass is not in effect, the associated trip channels must be declared inoperable as stated in Condition B.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

Technical Specification 3.3.1 and Basis 3.3.1 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

3.3 INSTRUMENTATION

3.3.1 Reactor Protection System (RPS) Instrumentation – Operating

LCO 3.3.1 Four RPS trip and associated operating bypass removal channels for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1

NOTE

1. Separate Condition entry is allowed for each RPS Function.
2. When one channel is bypassed and the bypassed condition exceeds 7 days, whether the operation with bypass state in one channel is allowed during Completion Times identified in Required Action A.2 or C.2.2 shall be reviewed within the next 24 hours in accordance with administrative controls.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Functions with one automatic RPS trip channel inoperable.	A.1 Place channel in bypass or trip. AND A.2 Restore trip channel to OPERABLE status.	1 hour ~~Prior to next entry into MODE 2 following entry into MODE 5~~
B. One or more Functions with two trip channels inoperable.	NOTE Only required to be met when COLSS is out of service. With COLSS in service, LHR is continuously monitored. B.1 Place one trip channel in bypass and the other in trip.	Prior to entering MODE 2 following next MODE 5 entry 1 hour

trip

automatic RPS

Delete

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. One or more Functions with one operating bypass removal channel inoperable.	C.1 Disable bypass channel. OR C.2.1 Place affected automatic trip channel in bypass or trip. AND C.2.2 Restore operating bypass removal channel and associated automatic trip channel to OPERABLE status.	1 hour 1 hour ~~Prior to next entry into MODE 2 following entry into MODE 5~~
D. One or more Functions with two operating bypass removal channels inoperable.	NOTE LCO 3.0.4 is not applicable. D.1 Disable bypass channels. OR D.2 Place one affected automatic trip channel in bypass and place the other in trip.	 1 hour 1 hour
E. Required Action and associated Completion Time not met.	E.1 Be in MODE 3.	6 hours

automatic

automatic

Prior to entering MODE 2 following next MODE 5 entry

Delete

BASES

ACTIONS (continued)

If one trip channel is inoperable, startup or power operation is allowed to continue, providing the inoperable channel is placed in bypass or trip in 1 hour. The 1 hour allotted to bypass or trip the trip channel is sufficient to allow the operator to take all appropriate actions for the failed trip channel and still ensures that the risk involved in operating with the failed trip channel is acceptable. The failed trip channel must be restored to OPERABLE status prior to next entry into MODE 2 following entry into MODE 5. With a trip channel in bypass, the coincidence logic is now in a two-out-of-three configuration.

The Completion Time prior to next entry into MODE 2 following entry into MODE 5 is based on adequate channel to channel independence, which allows a two-out-of-three channel operation since no single failure will cause or prevent a reactor trip.

B.1

Condition B applies to the failure of two channels in any RPS automatic trip Function.

~~The Required Action is modified by a Note stating that LCO 3.0.4 is not applicable. The Note is added to allow the changing of MODES, even though two trip channels are inoperable, with one trip channel bypassed and one tripped. In this configuration, the protection system is in a one-out-of-two logic, which is adequate to ensure that no random failure will prevent protection system operation.~~

Required Action B.1 provides for placing one inoperable trip channel in bypass and the other trip channel in trip within the Completion Time of 1 hour. This Completion Time is sufficient to allow the operator to take all appropriate actions for the failed trip channels while ensuring the risk involved in operating with the failed channels is acceptable. With one trip channel of protective instrumentation bypassed, the RPS is in a two-out-of-three logic; but with another trip channel failed, the RPS could be operating in a two-out- of-two logic. This is outside the assumptions made in the analyses and should be corrected. To correct the problem, the second trip channel is placed in trip. This places the RPS in a one-out-of-two logic. If any of the other OPERABLE trip channels receives a trip signal, the reactor will trip.

BASES

ACTIONS (continued)

One of the two inoperable channels will need to be restored to OPERABLE status prior to the next required CHANNEL FUNCTIONAL TEST, because channel surveillance testing on an OPERABLE channel requires that the OPERABLE channel be placed in bypass. However, it is not possible to bypass more than one RPS channel, and placing a second channel in trip will result in a reactor trip. Therefore, if one RPS channel is in trip and a second channel is in bypass, a third inoperable channel would place the unit in LCO 3.0.3.

C.1, C.2.1, and C.2.2

Condition C applies to one automatic operating bypass removal Function inoperable. If the inoperable bypass removal Function for any bypass channel cannot be restored to OPERABLE status within 1 hour, the associated trip channel may be considered OPERABLE only if the bypass is not in effect. Otherwise the affected trip channel must be declared inoperable, as in Condition A, and the affected automatic trip channel placed in bypass or trip. The operating bypass removal Function and the automatic trip channel must be repaired prior to next entry into MODE 2 following entry into MODE 5. The Bases for the Required Actions and required Completion Times are consistent with Condition A.

D.1 and D.2

Condition D applies to two inoperable automatic operating bypass removal Functions. If the operating bypass removal Functions for two operating bypasses cannot be restored to OPERABLE status within 1 hour, the associated trip channel may be considered OPERABLE only if the operating bypass is not in effect. Otherwise the affected trip channels must be declared inoperable, as in Condition B, and the operating bypasses either removed or one automatic trip channel placed in bypass and the other in trip within 1 hour. The restoration of one affected bypassed automatic trip channel must be completed prior to the next CHANNEL FUNCTIONAL TEST, or the plant must shut down per LCO 3.0.3 as explained in Condition B.

~~The Required Action is modified by a Note stating that LCO 3.0.4 is not applicable. The Note was added to allow the changing of MODES even though two channels are inoperable, with one channel bypassed and one tripped. In this configuration, the protection system is in a one-out-of-two logic, which is adequate to ensure that no random failure will prevent protection system operation.~~

REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**239-8076**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**10/09/2015**

Question No. 16-101

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

1. The applicant is requested to remove the blank line below the title, “SURVEILLANCE REQUIREMENTS,” of the surveillance requirements table of generic TS 3.3.4, and ensure three blank lines separate the actions table from the title of the surveillance requirements table, to conform to STS format convention.

2. Generic TS SR 3.3.4.4 is apparently an unintended duplication of SR 3.3.4.1; applicant is requested to remove this specification from generic TS Subsection 3.3.4.

3. The Bases for generic TS SR 3.3.4.3 (Perform CHANNEL FUNCTIONAL TEST on each RPS manual trip channel. | 31 days) does not describe how this surveillance is performed. The applicant is requested to add such a description to the Bases. Also explain why a 31 day Frequency is proposed instead of the corresponding STS SR 3.3.4.4 Frequency of “Once within 7 days prior to each reactor startup.”

4. On generic TS page B 3.3.1-34, under the heading Local Coincidence Logic Tests, the Surveillance Requirements section of the Bases for generic TS 3.3.1 says “Local coincidence logic (LCL) tests are described in LCO 3.3.4.” On page B 3.3.4-11, under headings SR 3.3.4.1 and LCL Testing, there is one sentence, which says “Automatic LCL

testing is performed to verify the operability of two-out-of-four logic and trip channel bypass logic." The applicant is requested to describe what is meant by "automatic LCL testing"; additional description of how the test is performed is also requested to be added to this LCL Testing discussion.

Response – (Rev. 1)

The following changes will be made to DCD Tier 2 TS 3.3.4 to be consistent with the information provided in NUREG-1432 Rev.4:

1. The blank line below the title, "SURVEILLANCE REQUIREMENTS," of the surveillance requirements table will be deleted and three blank lines that separate the actions table from the title of the surveillance requirements table will be maintained.

2. TS SR 3.3.4.4 will be deleted since it is a duplicate of 3.3.4.1.

3. The basis for TS SR 3.3.4.3 will be added to state that the surveillance is to verify that the RTCBs can be manually operated as designed. The 31 day Frequency of SR 3.3.4.3 is considered an acceptable equivalent for testing the RPS manual channel functional test once within 7 days prior to each reactor startup based on operating experience from the Korean operating fleet.

4. The word "automatic" will be deleted in the description of the LCL test since it is initiated manually from the MTP. The test confirms the trip path of the 2-out-of-4 coincidence logic for all input combinations. Bases page B 3.3.1-34 will be changed to add the additional description.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

The TS Bases for TS 3.3.4 will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Two channels of Manual Trip, RTSG, or RPS logic affecting the same trip leg inoperable.	C.1 Open affected RTSGs.	Immediately
D. Required Action and associated Completion Time of Condition A or C not met. OR One or more Functions with more than two channels of Manual Trip, RTSG, or RPS logic inoperable for reasons other than Condition C.	D.1 Be in MODE 3. AND D.2 Open all RTSGs.	6 hours 6 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.3.4.1	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and RTSG channel.	31 days
SR 3.3.4.2	Perform CHANNEL FUNCTIONAL TEST, including separate verification of undervoltage and shunt trips, on each RTSG.	18 months
SR 3.3.4.3	Perform CHANNEL FUNCTIONAL TEST on each RPS manual trip channel.	31 days
SR 3.3.4.4	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and RTSG channel.	31 days

Delete

BASES

SURVEILLANCE REQUIREMENTS (continued)

The RPS CHANNEL FUNCTIONAL TEST consists of overlapping tests as described in DCD Tier 2, Section 7.2 (Reference 3). These tests verify that the RPS is capable of performing its intended function, from bistable input through the RTSGs.

Bistable logic test is described in SR 3.3.1.7. This SR describes two kinds of test related to RPS logic which includes coincidence logic and trip path (initiation logic).

LCL Testing

~~Automatic~~ LCL testing is performed to verify the operability of two-out-of-four logic and trip channel bypass logic.

Trip Path Testing The LCL test is initiated manually from the MTP. The trip path of 2-out-of-4 coincidence logic is tested for all input combinations.

The RTSG test is a manually initiated test. The test is manually initiated because the test philosophy requires operator involvement in the testing and reclosing of these important reactor trip devices. The operator can obtain status information from the breaker open/close indication and current monitors and thus determine the success or failure of the test. The RTSGs must then be closed prior to testing the other three initiation circuits, or a reactor trip could result.

SR 3.3.4.2

Each RTSG is actuated by an undervoltage coil and a shunt trip coil. De-energizing the undervoltage coil or energizing the shunt trip coil will cause the circuit breaker to open. The PPS interfaces with the undervoltage trip device of RTSS breakers. The DPS interfaces with the shunt trip device of the RTSS breakers. The actuation of either the undervoltage or the shunt trip device interrupts power from the motor generator (MG) sets to the control element drive mechanisms (CEDMs). When an RTSG is opened, either during an automatic reactor trip or by using the manual push switches in the MCR, the undervoltage coil is de-energized and the shunt trip coil is energized. This makes it possible to determine if one of the coils or associated circuitry is defective.

BASES

SURVEILLANCE REQUIREMENTS (continued)

Therefore, once every 18 months, a CHANNEL FUNCTIONAL TEST is performed, that individually tests all four sets of undervoltage coils and all four sets of shunt trip coils. During undervoltage coil testing, the shunt trip coils must remain de-energized, preventing their operation. Conversely, during shunt trip coil testing, the undervoltage coils must remain energized, preventing their operation.

This Surveillance ensures that every undervoltage coil and every shunt trip coil is capable of performing its intended function, and that no single active failure of any RTSG component will prevent a reactor trip. The 18-month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillance when performed at the Frequency of once every 18 months.

SR 3.3.4.3

A CHANNEL FUNCTIONAL TEST on the manual trip channels is performed periodically once every 31 days to ensure the entire channel will perform its intended function if required.

REFERENCES

1. 10 CFR Part 50, Appendix A.
2. 10 CFR 50.34.
3. DCD Tier 2, Section 7.2.

Manual Trip testing is performed to verify that the RTCBs can be manually operated as designed. The 31-day Surveillance period has been determined based on operating experience to be an adequate period of time to provide assurance that the RPS manual trip channel can satisfactorily perform its intended function.

REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**239-8076**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3**
Date of RAI Issue:	**10/09/2015**

Question No. 16-102

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility.

NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements.

1. Generic TS LCO 3.3.4 requires in part that “four manual trip channels shall be OPERABLE”; STS LCO 3.3.4 requires in part that “four channels of Manual Trip shall be OPERABLE.” Since the phrase “channel(s) of Manual Trip” or Manual Trip channel(s) is used in the generic TS 3.3.4 ACTIONS Table, as does the STS 3.3.4 ACTIONS table, the applicant is requested to also use “Manual Trip” in the statement of LCO 3.3.4 and in the statement of SR 3.3.4.3, and make conforming changes, where appropriate, to the generic TS 3.3.4 Bases.

2. The second Applicability statement of generic TS 3.3.4 wraps to a second line, but the second line is not indented as stipulated by STS format convention. The applicant is requested to correct this human interface format nonconformance.

3. Regarding generic TS 3.3.4 and STS 3.3.4:

a. The second condition statement of generic TS 3.3.4 Condition D and the corresponding second condition statement of STS 3.3.4 Condition E begin with the phrase “One or more Functions with more than . . .” Since none of the other condition statements use this phrase, the applicant is requested to justify using it in Condition D.

b. The second condition statement of Condition D of generic TS 3.3.4 differs from corresponding Condition E of STS 3.3.4 by saying “more than two channels” instead of “more than one channel”; and “inoperable for reasons other than Condition C” instead of “inoperable for reasons other than Condition D.” Generic TS 3.3.4 Condition C (Two channels of Manual Trip, RTSG, or RPS logic affecting the same trip leg inoperable.) is equivalent to STS 3.3.4 Condition D (Two channels of Manual Trip, RTCB, or Initiation logic affecting the same trip leg inoperable.) The applicant is requested to justify the difference or revise Condition D of generic TS 3.3.4 to say:

One or more Functions with more than one channel of Manual Trip, RTSG, or RPS logic inoperable for reasons other than Condition C.

Response – (Rev. 1)

The following responses are provided pertaining to questions regarding DCD Tier 2 TS LCO 3.3.4 and associated Bases:

1. The phrases “four manual trip channels” and “each RPS manual trip channel” will be changed to “four channels of Manual Trip” and “each RPS Manual Trip channel”, respectively. The phrase “the manual trip channels” in the SR 3.3.4.3 Bases will also be changed to “the Manual Trip channels.”

2. The second line of the second Applicability statement will be modified to conform to the TS formatting guideline.

3.a The phrase “One or more Functions with more than…” described in Condition D is used instead of “One or more Functions with two channels…” since TS 3.3.4 Condition C already states the phrase “Two channels of …” related to the same leg.

3.b. The second condition statement of Condition D will be changed to state “One or more Functions with more than one channel of Manual Trip, RTSG, or RPS logic inoperable for reasons other than Condition C.”

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS LCO 3.3.4 and the associated Bases will be revised as indicated in the Attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

3.3 INSTRUMENTATION

3.3.4 Reactor Protection System (RPS) Logic and Trip Initiation

LCO 3.3.4 Four RPS logic channels (Coincidence, Initiation Logic), four channels of Reactor Trip Switchgears (RTSGs), and four ~~manual trip channels~~ channels of Manual Trip shall be OPERABLE.

APPLICABILITY: MODES 1 and 2,
MODES 3, 4, and 5, with any RTSGs closed and any control element assemblies capable of being withdrawn.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ---------- NOTE ---------- RTSGs associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST ---------- One channel of Manual Trip, RTSG, or RPS logic inoperable in MODE 1 or 2.	A.1 Open affected RTSGs.	1 hour
B. ---------- NOTE ---------- RTSGs associated with one inoperable channel may be closed for up to 1 hour for the performance of an RPS CHANNEL FUNCTIONAL TEST ---------- One channel of Manual Trip, RTSG, or RPS logic inoperable in MODE 3, 4, or 5.	B.1 Open affected RTSGs.	48 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Two channels of Manual Trip, RTSG, or RPS logic affecting the same trip leg inoperable.	C.1 Open affected RTSGs.	Immediately
D. Required Action and associated Completion Time of Condition A or C not met. OR One or more Functions with more than ~~two~~ ~~channels~~ of Manual Trip, RTSG, or RPS logic inoperable for reasons other than Condition C.	D.1 Be in MODE 3. AND D.2 Open all RTSGs.	6 hours 6 hours

channel

one

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.3.4.1	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and RTSG channel.	31 days
SR 3.3.4.2	Perform CHANNEL FUNCTIONAL TEST, including separate verification of undervoltage and shunt trips, on each RTSG.	18 months
SR 3.3.4.3	Perform CHANNEL FUNCTIONAL TEST on each RPS ~~manual trip~~ channel.	31 days
SR 3.3.4.4	Perform CHANNEL FUNCTIONAL TEST on each RPS logic channel and RTSG channel.	31 days

Manual Trip

BASES

SURVEILLANCE REQUIREMENTS (continued)

Therefore, once every 18 months, a CHANNEL FUNCTIONAL TEST is performed, that individually tests all four sets of undervoltage coils and all four sets of shunt trip coils. During undervoltage coil testing, the shunt trip coils must remain de-energized, preventing their operation. Conversely, during shunt trip coil testing, the undervoltage coils must remain energized, preventing their operation.

This Surveillance ensures that every undervoltage coil and every shunt trip coil is capable of performing its intended function, and that no single active failure of any RTSG component will prevent a reactor trip. The 18-month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown these components usually pass the Surveillance when performed at the Frequency of once every 18 months.

SR 3.3.4.3

Manual Trip

A CHANNEL FUNCTIONAL TEST on the ~~manual trip~~ channels is performed periodically once every 31 days to ensure the entire channel will perform its intended function if required.

REFERENCES

1. 10 CFR Part 50, Appendix A.
2. 10 CFR 50.34.
3. DCD Tier 2, Section 7.2.